TECHNOLOGY DEPT.

POWER

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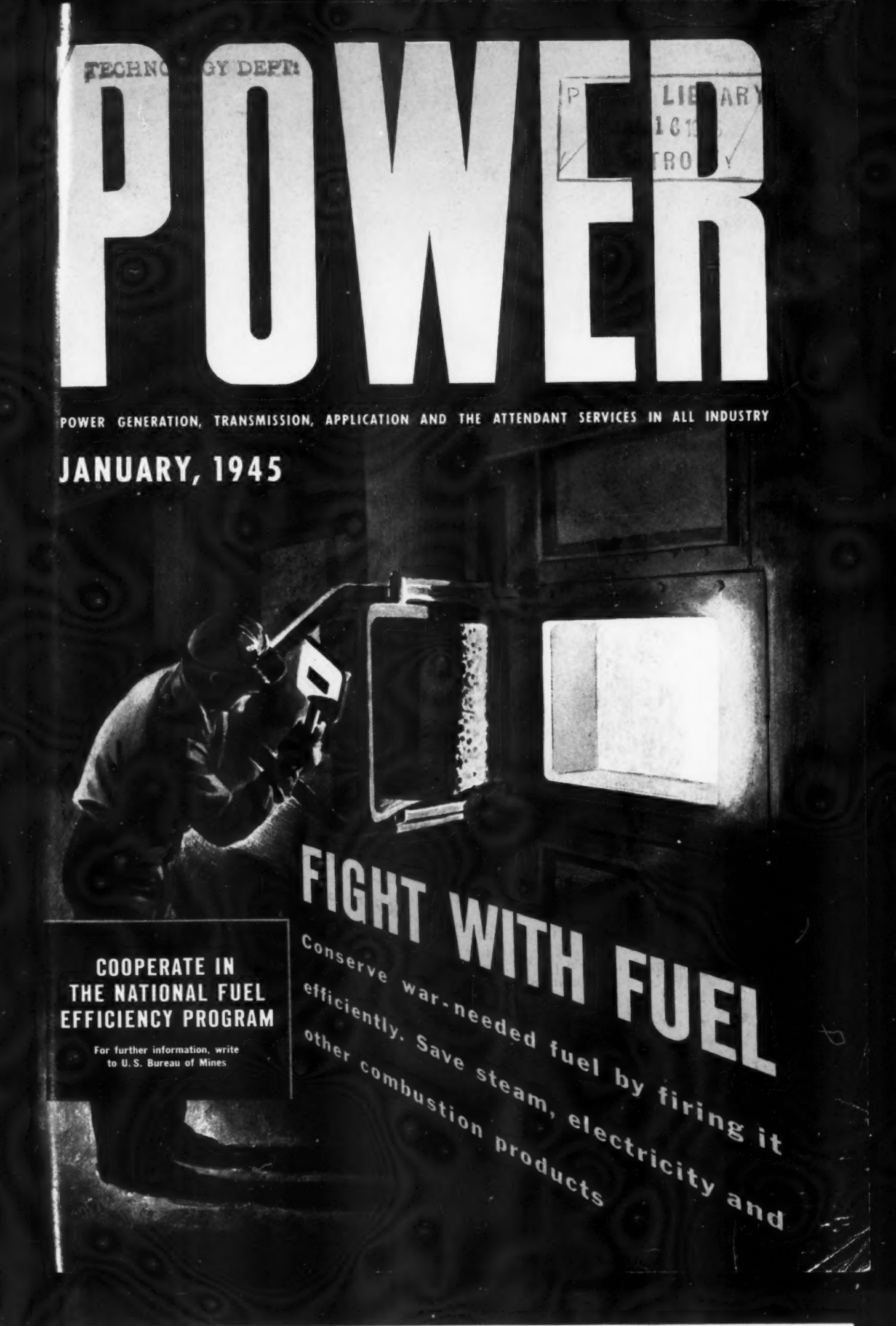
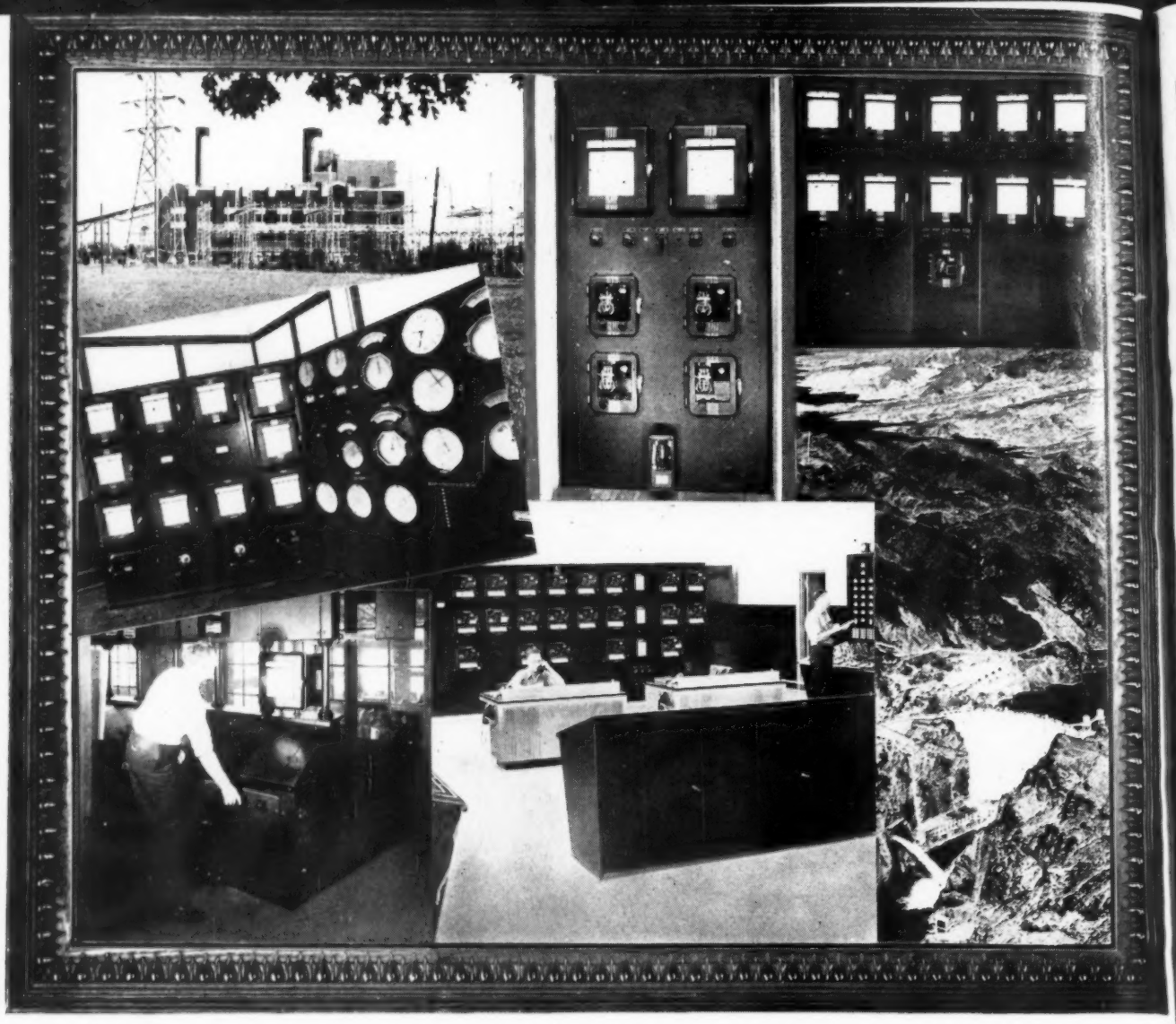
POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY

JANUARY, 1945


FIGHT WITH FUEL
Conserve war-needed fuel by firing it efficiently. Save steam, electricity and other combustion products
COOPERATE IN THE NATIONAL FUEL EFFICIENCY PROGRAM
For further information, write to U. S. Bureau of Mines



A few L&N Load-Frequency Control panels, and two of the many stations which use this equipment to regulate most of America's interconnected load

THE LOAD-CONTROL PICTURE ~~CAN~~ will CHANGE!

Helping to make the best use of a power interconnection—that's the job of L&N Load-Frequency Controllers. It's a task which changes, with time, on most networks. Today the problem may be to increase the amount of power on a tie, by preventing surges so that the average transfer is increased . . . Tomorrow, this same accurate control may help to rush power into an area which has lost a generator by some accident . . .

And, day after tomorrow, the L&N Controllers may be helping provide power at minimum cost. The accuracy of these instruments will be a great help when a cost differential of perhaps half a mill per kwhr will decide which stations are to operate, and what load. L&N equipments will operate every unit just as directed—help shave the ultimate fraction from costs.

L&N Load-Frequency Control is outlined in our Technical Publication N-56-161(1), free on request.

Here are the types of L&N Load-Frequency Control you can employ to meet changing power situations:

Economic Load Control

Tie Line Load Control

Flat Frequency Control

Telemetering, Recording, Totalizing of Load

Recording of Frequency

ARMY E NAVY

depends on me!

A Slogan For Every American

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-56-161 (5)

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), January, 1945, Vol. 84, No. 1. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publications office, 99-129 North Broadway, Albany 1, N. Y. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Please indicate position and company connection on all subscription orders. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

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DETROIT

True Values are proved under stress!...

It is the ability to withstand shocks and strains and overload that proves character.

American industry has proved its character—its fundamental soundness. Under the stresses and strains and overload of war, America's great industrial machine has performed wonders in production. The ideals of the Nation's founders have been defended, not alone by a courageous and united people, but also by an industry they created in their own image.

In this year, 1945, the entire civilized world is grateful for America's proved ability to produce. To the extent that Link-Belt Company contributes to production, throughout industry, we wish to express our gratitude for our opportunities to serve mankind in war and in peace.

W. C. Carter
PRESIDENT

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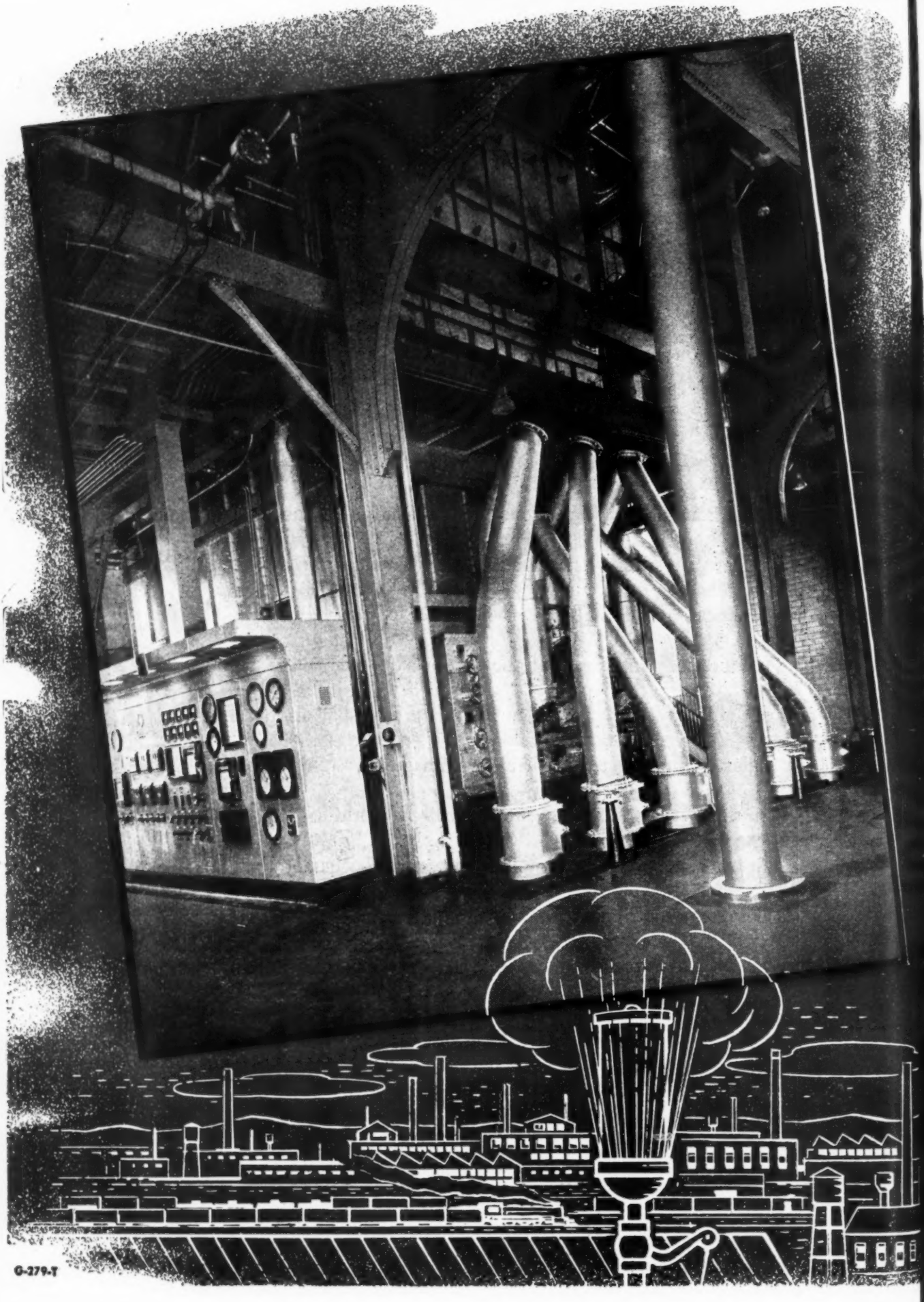


G-279-T

Victory Will Mean

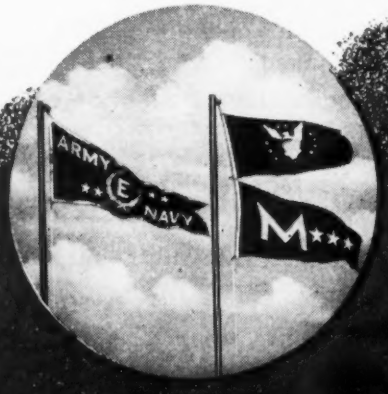
NEW JOBS *for* STEAM

Steam will blow the whistles when the big news comes. But, in heralding the great day, steam will have done far more than sound the signal for rejoicing.

Beyond steam's part in victory . . . beyond its record of powering ships, trains, war plants, there will be thousands of stories of men . . . *engineers* . . . men with trigger minds instead of trigger fingers . . . who tackled power plant problems with keen resourcefulness so that power for war needs would never be "too little or too late". With the end of hostilities will come new Victory jobs for steam . . . new problems . . . keener competition that will put emphasis on operating costs.

With today's accelerated experience yielding more complete answers to such problems as behavior of metals at high temperatures, action of fuels in slag-tap and dry-ash furnaces, circulation in high-capacity high-pressure boilers, separation of steam from water in boiler steam drums, and other related problems, the boilers of tomorrow will be even better able to serve industry.

Building boiler units complete with all essential components . . . controlling both the design and the application of the equipment fabricated . . . these, plus extensive facilities, give us at B&W a background that's unique. As a result our engineers have at their disposal an array of boilers from which to meet any combination of conditions of capacity, pressure, temperature, feedwater, fuel, and space. Now is a good time to consult with us regarding your steam plant requirements for the future.

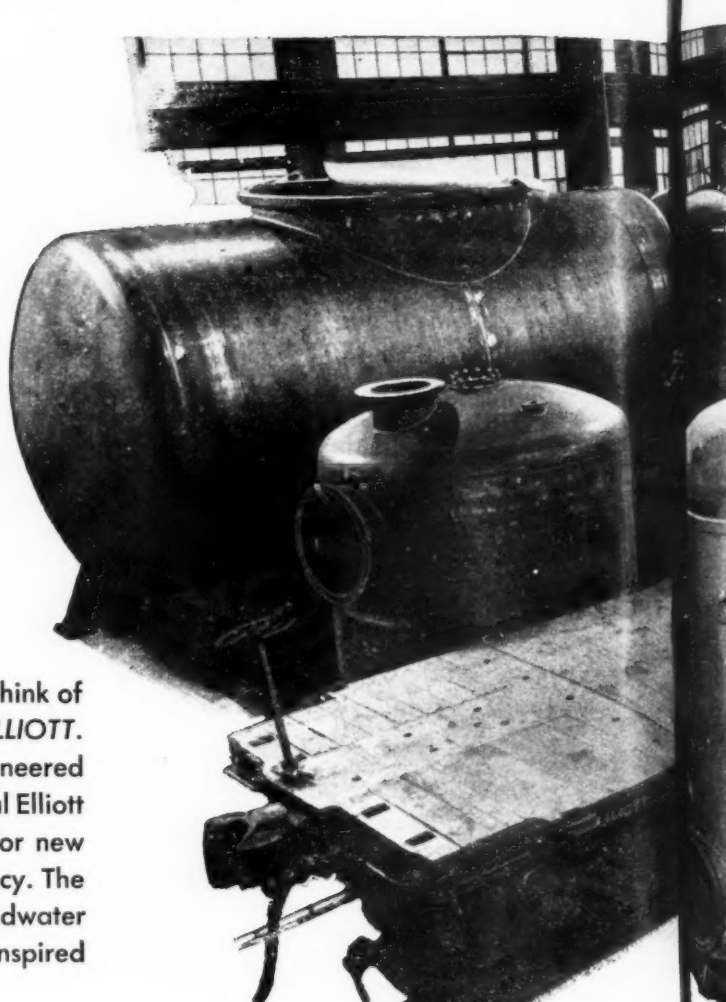


Army-Navy "E" flags have been awarded to five B&W plants, and also the Maritime Commission Award flags to the Barberton, Ohio, Plant.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N. Y.

Deaeration for the seven se



This group of Elliott deaerating feedwater heaters will have a varied and interesting career. Some of them are destined for aircraft carriers. Others for troop transports, for destroyers, for Victory ships. And in the background, two vertical deaerating heaters with horizontal storage tanks, for important public utility plants making power for the home front.

AFLOAT OR ASHORE, when engineers think of *deaeration* they generally think of *ELLIOTT*. For the deaeration principle was first pioneered by Elliott engineers, striking out with typical Elliott enterprise into untrodden fields, aiming for new goals of steam plant economy and efficiency. The successful combining of deaeration and feedwater heating in a single unit is the result of this inspired effort.

With a vast file of correlated data at their command, Elliott engineers design deaeration equipment to meet each individual job or set of conditions, no matter how exceptional those conditions may be.

Your deaeration problem may be simple or complicated. In either case you can with advantage discuss it with Elliott engineers.

ELLIOTT COMPANY

Deaerator & Heater Department • **JEANNETTE, PA.**

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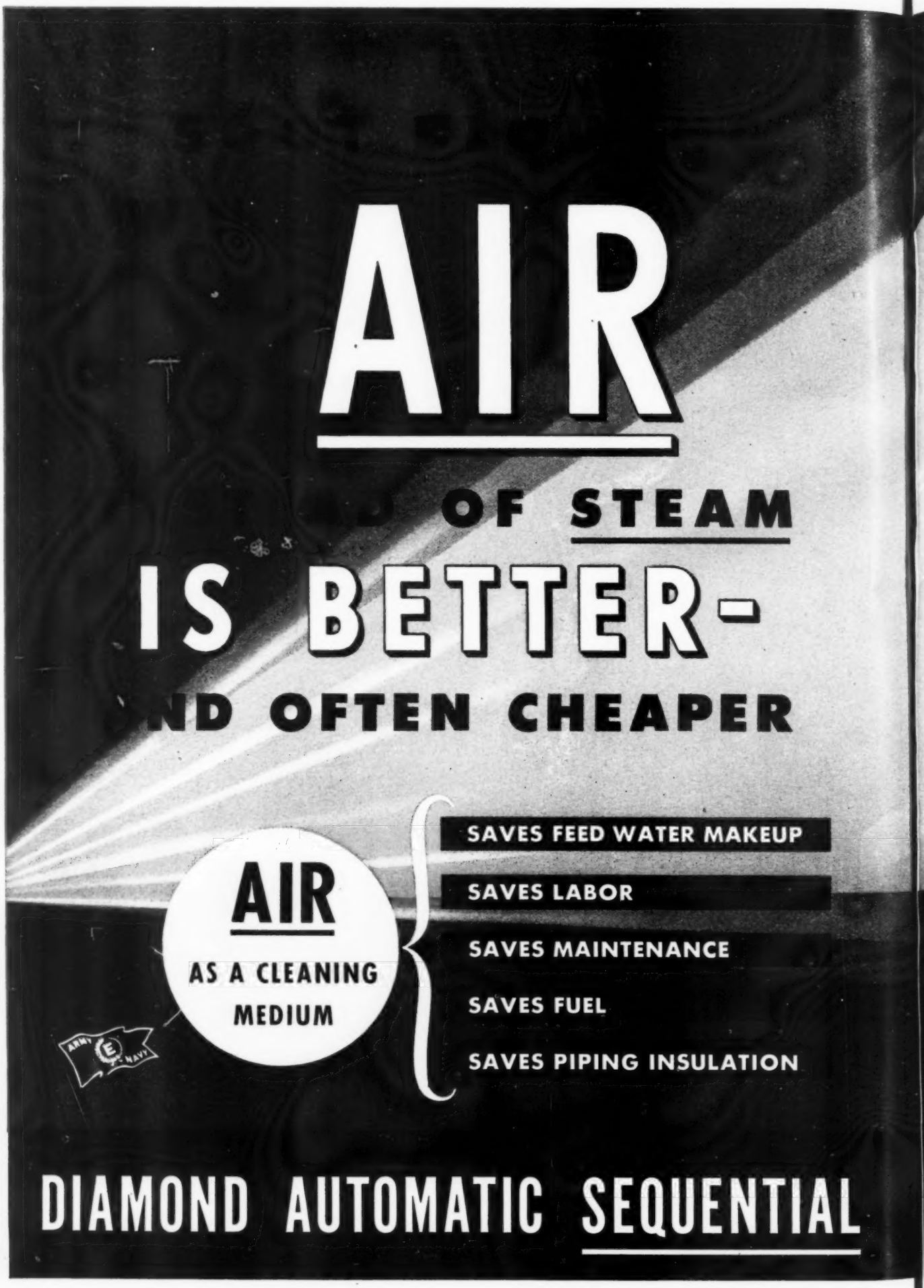
n seas - *and for the home front too.*

N-981

OTT pioneered deaeration
– and is still ahead!


AIR
OF STEAM
IS BETTER-
ND OFTEN CHEAPER
AIR
AS A CLEANING
MEDIUM
SAVES FEED WATER MAKEUP
SAVES LABOR
SAVES MAINTENANCE
SAVES FUEL
SAVES PIPING INSULATION
ARMY E NAVY
DIAMOND AUTOMATIC SEQUENTIAL

There is no condensate loss due to soot blowing using compressed air instead of steam as the cleaning medium, with the Diamond Automatic Sequential Air System. This is a particularly important feature where feed water makeup is a problem. And having a greater density than steam, compressed air provides better cleaning.

The air is discharged from permanently installed elements (see below) in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time eliminates stack discharge nuisance and permits use of a much smaller compressor.

The "human element" is entirely eliminated from soot blowing by the Diamond automatic sequential system which assures the positive operation of each blower unit in correct sequence and at the right speed every time. No blower unit can be overlooked or incorrectly operated by a careless operator. All soot blower units on the boiler, superheater, economizer, and air heater are controlled from a single panel (see below).

Labor is saved because no attendant is needed to drain the piping, warm it up and then operate each individual blower unit. Experience gained during several years' operation on a number of installations proves that maintenance costs are unusually low and that air blowing requires only 1/3 to 2/3 of the energy from the coal pile that is needed for steam blowing.

The Diamond Automatic Sequential Air Soot Blower System has been in successful central station use on boilers as large as 900,000 lb/hr units since 1940. For further information ask for Bulletin No. 956.

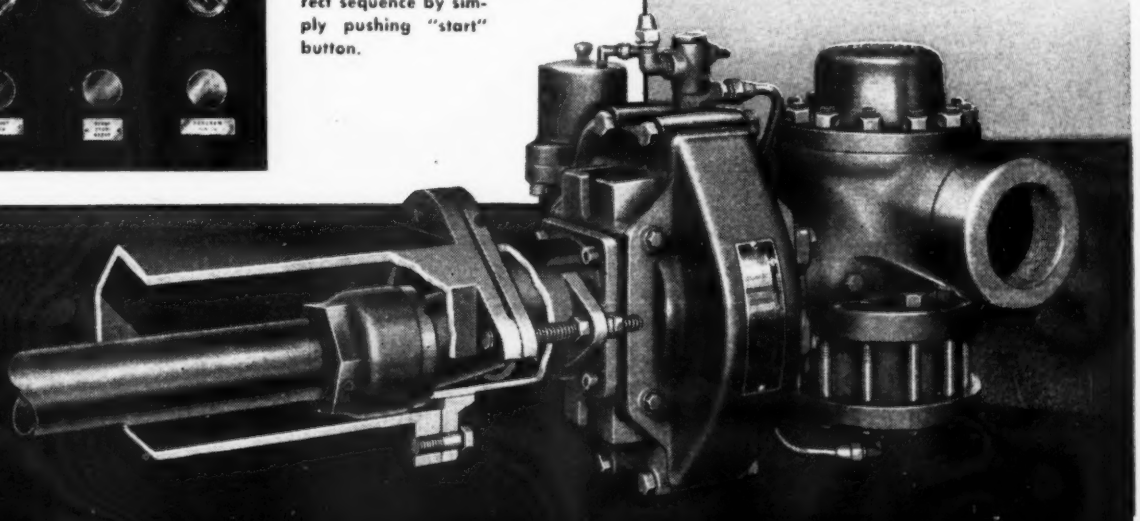
DIAMOND POWER SPECIALTY CORPORATION

Detroit 31, Michigan

Diamond Specialty Limited • Windsor, Ontario

Program panel at left controls both fixed and retracting blowers arranged in three groups; any desired number of groups can be had when system is designed. Entire soot blowing system is operated in correct sequence by simply pushing "start" button.

Shown below is the Diamond Air Puff Soot Blower having element permanently installed inside the setting; various types of retracting soot blowers are also used in the Diamond Automatic Sequential Air Soot Blower System.

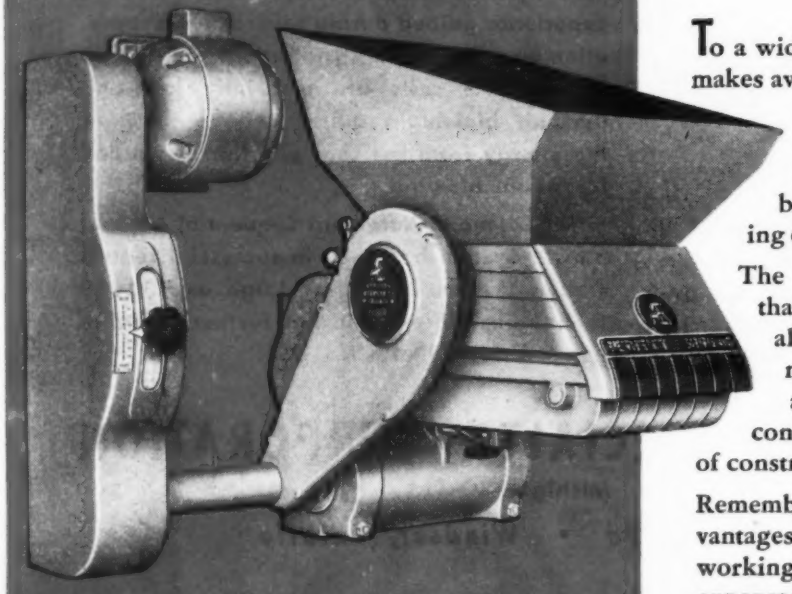


Air SOOT BLOWER SYSTEM

ANNOUNCING

THE

Æ PERFECT SPREAD STOKER



To a wider group of steam producers, Æ now makes available a modern, completely automatic stoker that is up-to-the-minute in every feature. It's the Æ Perfect Spread Stoker taking its "streamlined" bow—backed by 38 full years of *stoker* engineering experience in the large power plant field.

The Perfect Spread Stoker eliminates tasks that spell boiler room drudgery. It burns all kinds and grades of solid fuel with maximum efficiency. And it owes unusually quiet, reliable operation to a new conception of stoker design and simplicity of construction.

Remember these time- and money-saving advantages when thinking of your own boiler room, working conditions, steam costs, and operating expenses. By all means, write now for the new bulletin that tells you how to produce more steam at lower cost... with the Æ Perfect Spread Stoker.

FEATURES TUNED TO THE FUTURE

- Improved Streamlined Design
- Completely Automatic—Amazingly Quiet
- Burns wide range of Solid Fuels
- Fully Protected, Accessible Mechanism
- Non-Clog Safety Feature
- Water Cooling at Vital Points
- Exclusive "Cross-Firing" Grate Design
- Easily Installed
- Low Initial and Operating Costs

. . . and more

IF YOUR Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

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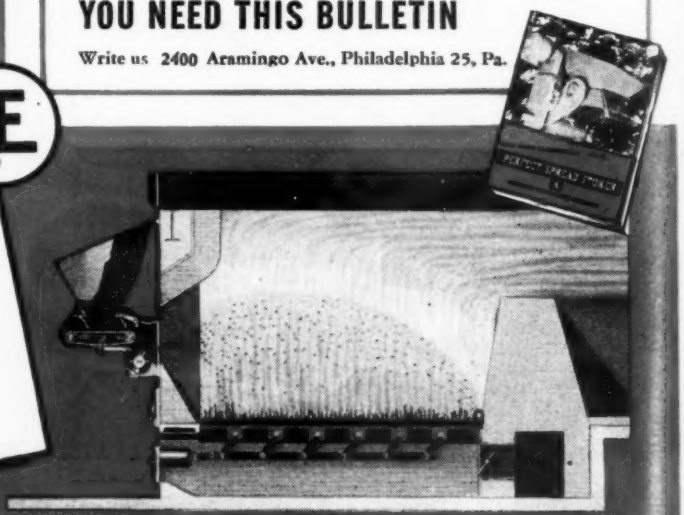

Æ

Æ PERFECT SPREAD STOKER

Other Æ Products: Taylor Stokers, La-Mont Boilers, Morton Bank Auxiliaries, Bole-Shaw Field Power, Diamond Face Grinders

AMERICAN ENGINEERING COMPANY

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ANNOUNCING....

THE IMPROVED

Æ TAYLOR STOKER

TYPE "R"

It is probably no news to you that many hundreds of the Nation's boilers are fired by Taylor Stokers. Or that the record of Taylor Stokers is one of highly efficient, reliable steam generation for the past 38 years.

But now . . . sweeping improvements . . . long in preparation . . . have been combined to add *new* efficiency to time-tested Taylor Stoker principles. Simplification is the keynote. Simplified construction, installation, operation and maintenance mean more thorough combustion, less frequent outages, at a lower net cost.

These valuable new features and their direct advantages may have an important bearing on your future operations. Arm yourself *now* with the facts that will help make your decision on stoker equipment 100% right. Send today for the new Type "R" Taylor Stoker booklet.

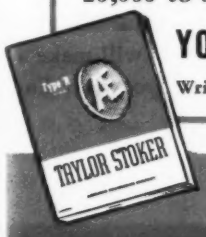
OUTSTANDING *FEATURES* OF THIS *IMPROVED* TIME-TESTED STOKER

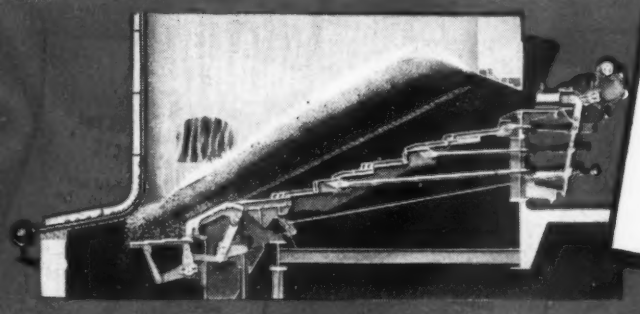
- Simplified Construction Throughout
- A Completely Self-Contained, Self-Supporting Unit
- Easily Installed
- Fewer Moving, Longer Wearing Parts
- Precision Control Feed Mechanism
- Unique Hydraulic Drive Continuous Ash Discharge with Automatic Timing
- "Finger-Tip" Action Steam Power Dump
- Air-Operated Clean-Out Dampers
- Better Air Flow—More Thorough Combustion
- Minimum Stack Discharge
- Quick-Firing—Adequate Reserve Capacity
- Available in Air or Water Cooled Design
- Air Cooled—Easily Converted to Water Cooled
- Burns Wide Range of Coals

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

Write us. 2400 Aramingo Avenue, Philadelphia 25, Pa.





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Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

Other Æ Products: Perfect Spread Stoker, Le-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power, Diamond Face Grinders

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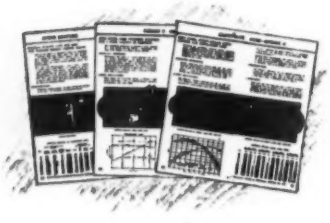
Consult this section to select the type of air handling equipment that will serve you better—and most economically. You'll find the Sturtevant line complete — from the tiniest blower to a fan standing thirty feet high. A wide variety of equipment



for every application is illustrated and described here, giving advantages, condensed construction features, dimensions, performance and capacity tables—equipment that stands for the ultimate in air engineering.

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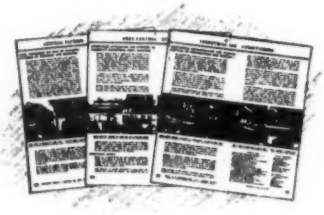
Leaf through these pages to find how "Air at Work" steps up efficiency of plants and processes. Typical examples show how air handling equipment that's properly engineered and installed purifies the air, heats or cools it, makes it wet or



dry, conveys, removes fog, fume or dust; burns coal, oil and gas *more efficiently* — in short, offers a means of mastering competition wherever men and machines operate.

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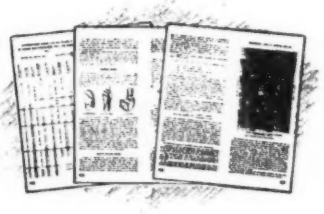
You'll have occasion to refer to this section again and again for its wealth of helpful air engineering data. Included here are many frequently used air laws and formulas, many tables and design shortcuts in more convenient, more usable form,



many charts and diagrams *never before available.* Every page, representing years of practical field and laboratory experience, will make a valuable addition to your Air Engineering library.

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A handy index and cross reference chart shows you every piece of equipment Sturtevant makes, what each is used for and where to find it.
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In this book you'll find the right air handling equipment — the right design data — for both new constructions and replacements.
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The fact-packed section on types, functions and advantages of equipment for "putting air to work" is a real production tool.
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How it is used

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- Industrial Air Conditioning
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- Auxiliary Motive Power
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IT'S ALL UNDER ONE COVER — the essential information you need when you design, specify or order air handling and allied equipment or systems —as well as aid in choosing subjects on which you want detailed information or competent engineering help.

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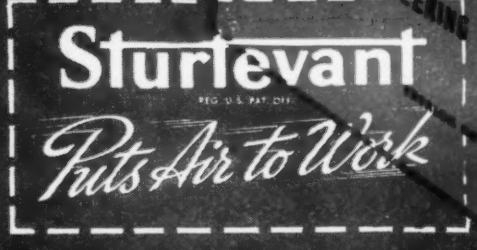
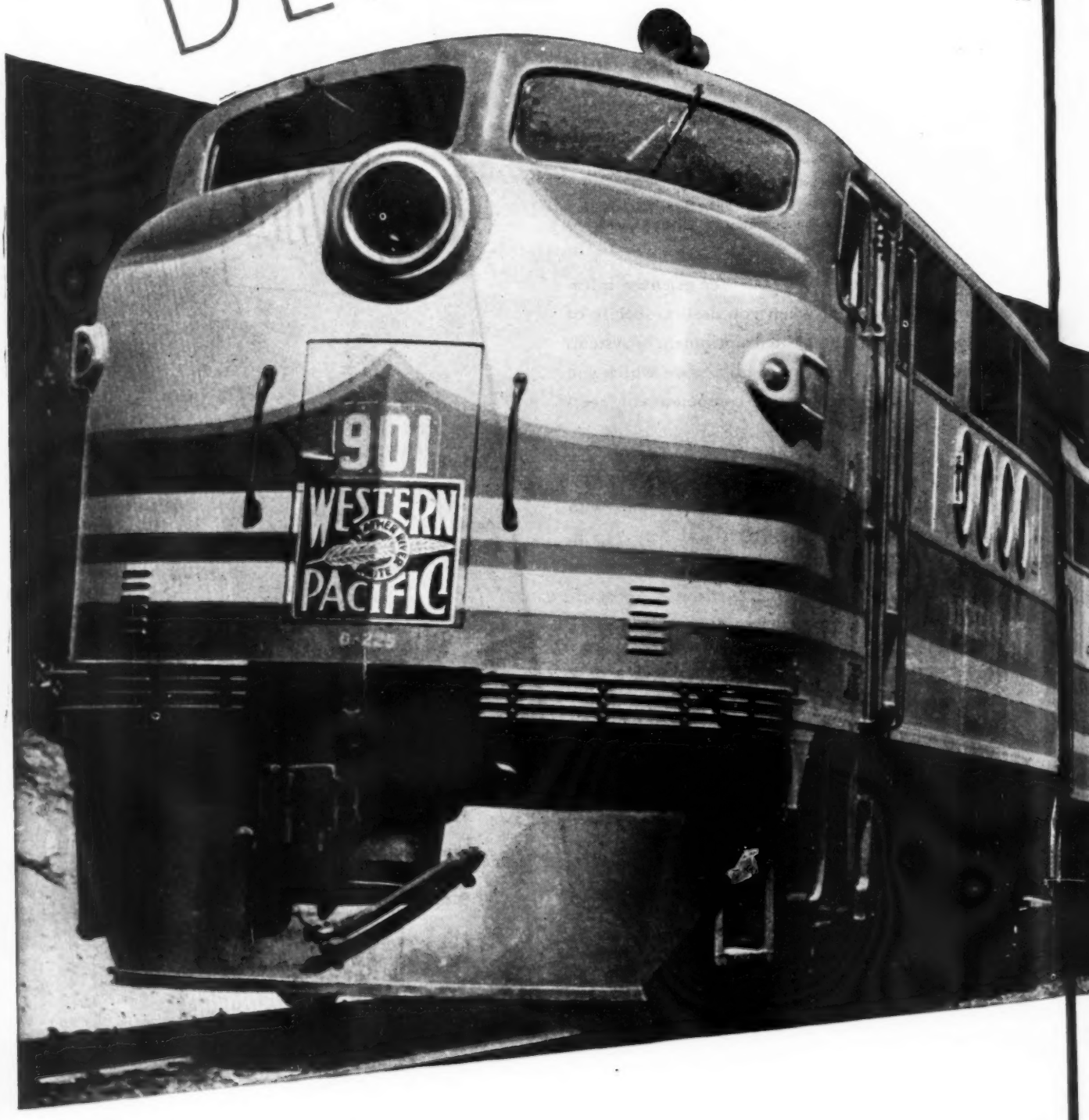
B. F. STURTEVANT COMPANY
P.O. Box 97 • Hyde Park, Boston 36, Mass.

FOR PRODUCTION MANAGERS
This book will be extremely helpful in selecting equipment that assures maximum efficiency for all your air handling jobs.



THE TREND'S TO DIESELS

DEFINITELY



TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON SUNDAY NIGHTS

SINCE 1940, the use of Diesel electric locomotives on major U. S. railroads has increased more than 350 per cent. Typical of the powerful Diesel locomotives now in service is Western Pacific's "901", consisting of four sections, each with a 16-cylinder, 2-cycle engine capable of developing 1350 hp. at 800 rpm.

Use of Diesels in stationary installations is also increasing. But wherever Diesels are used—in stationary plants or mobile equipment—on land or sea—they operate more efficiently when lubricated with Texaco.

Texaco Ursa Diesel lubricants constitute a complete line of oils. There is one to meet the lubrication requirements of every type of Diesel engine. They increase the life of rings, pistons, liners and bearings by overcoming scuffing, ring-sticking, sludge and corrosion. Because of these benefits—

More stationary Diesel hp. in the U. S. is lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer, specializing in Diesel lubrication, will gladly recommend the most suitable type and grade of *Texaco Ursa Oil* for your engine. Phone the nearest of more than 2300 Texaco distributing points in the 48 States or write:

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The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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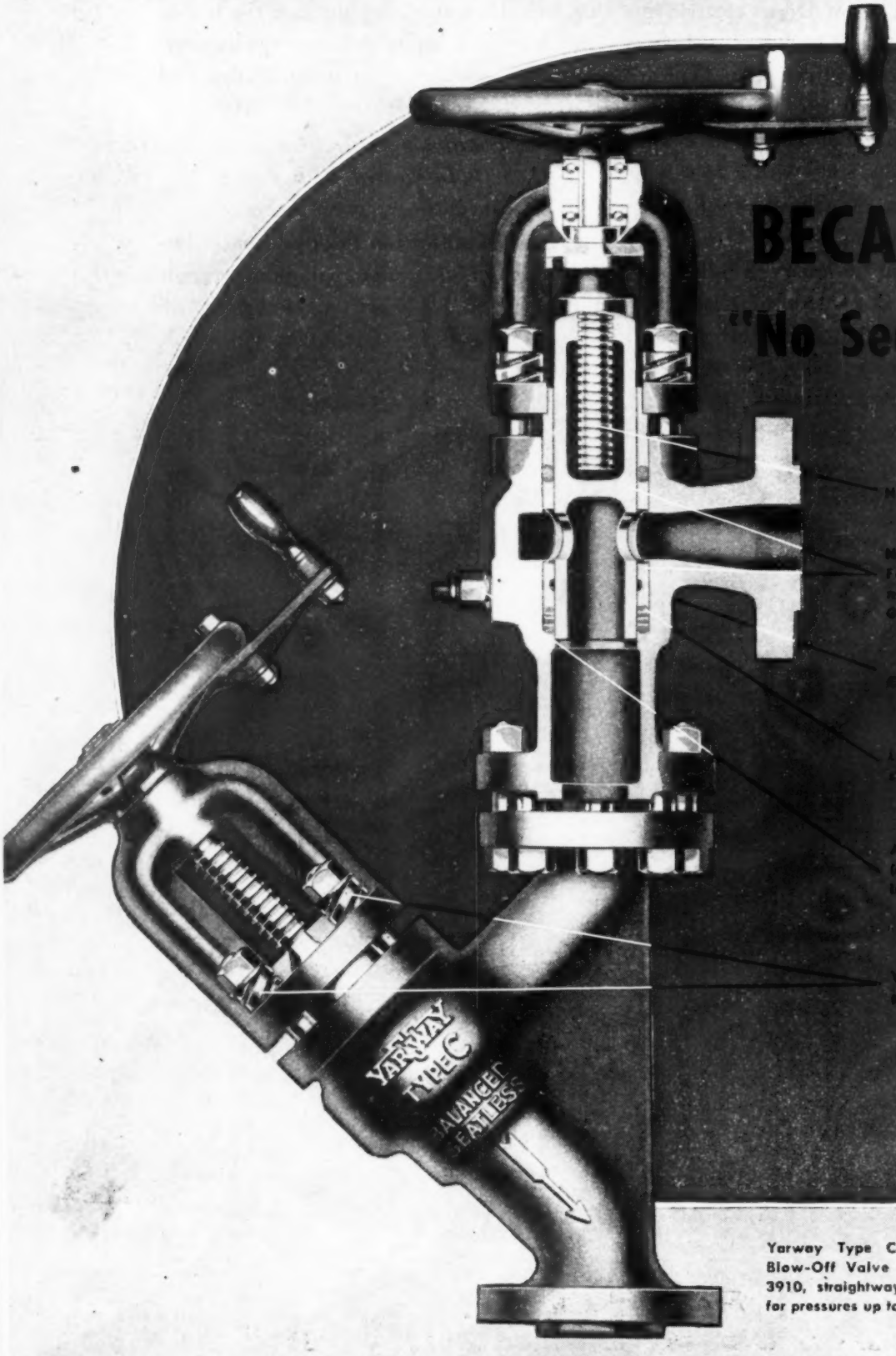
FOR ALL DIESEL ENGINES

METROPOLITAN OPERA BROADCASTS SATURDAY AFTERNOONS

The Seatless Blow-Off Valve . . .



BECAUSE ★ ★ ★

"No Seat to Scor

Heat-treated steel stem.

Nitralloy Plunger and Lower Follower Gland. Monel condenser T100 (upper Follower Gland, chromium plated steel).

Cast Steel Body and Yoke.

Laminated packing rings with stainless steel retaining rings.

Alemite lubrication of Plunger (also for ball thrust bearings in yoke).

Yoke Springs maintain resilient pressure on packing at all times.

Yarway Type C Seatless Tandem Blow-Off Valve (angle valve Fig. 3910, straightway valve Fig. 3912) for pressures up to 600 lbs.

YARWAY

"Standard" in Over 12,000 Plants

Wear and Clog with Mud, Scale and Dirt"

More than a quarter century ago, Yarway introduced their Seatless Blow-Off Valve and said—"No seat to score, wear and clog with mud, scale and dirt." Power plant operators, harassed by continuous trouble and expense with conventional valves—welcomed the Yarway as the answer to their troubles . . . purchased them, watched them, standardized upon them. And the Yarway Seatless design, in a relatively short time, became the most widely preferred blow-off valve.

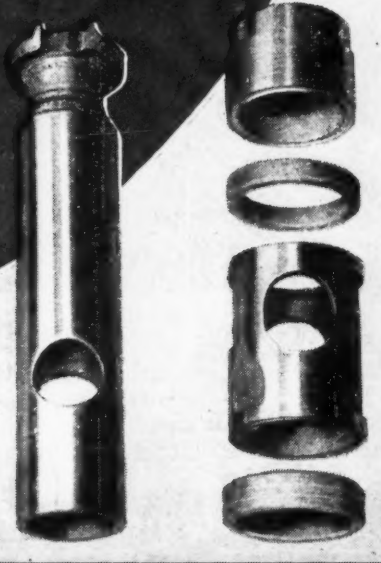
Today, after a quarter century of service, it still holds that distinction. Sound fundamental design . . . coupled with continuous mechanical and metallurgical research anticipating ever-new service requirements . . . makes the highly improved Yarway Seatless Valve of today just as good insurance against blow-down trouble and expense in today's plants as it was in the plants of twenty-five years ago.

There is a Yarway Valve for every pressure and purpose. Write for Catalog B-424 for pressures up to 400 lbs. Catalog B-431 for higher pressures.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

More ample chaco for free flow with no projections or pockets to accumulate scale or sediment.

Pressure compounds Plunger moving a fully balanced valve, easy to operate regardless of pressure.



Nitralloy Plunger and lower Follower Gland, and laminated packing with stainless steel inserts, add years to valve life.

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BLOW-OFF VALVES

See how Easy it is to put this on this

One quick operation and Allis-Chalmers' new "Magic-Grip" — *fastest mounting sheave on the market* — is locked securely to shaft... saving you time, money, trouble!

1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

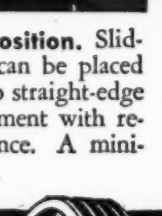
2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge ... giving you true alignment with resulting smooth performance. A minimum of time is required.

3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1750

Allis-Chalmers Texrope

"MAGIC-GRIP"



SHEAVES

CAPACITORS REDUCE YOUR KVA DEMAND

"The capacitors reduced the demand of our welders from 150 kva to 54.6 kva. A serious wiring and power-factor problem within our factory was solved, and a bad light flicker was eliminated."

. . . An Illinois engineering firm

THEY BOOST A CIRCUIT'S LOADABILITY

"The 90 kva of capacitors increased our capacity 30 per cent. We've been able to connect more motors, without adding to wire, main switch, fuse, or transformer capacity."

. . . A Nebraska iron foundry

THEY IMPROVE VOLTAGE AND PERFORMANCE OF EQUIPMENT

"Voltage improved . . . power factor now unity . . . production speeded up . . . lighting flicker eliminated."

. . . A Michigan steel company

THEY REDUCE YOUR POWER COSTS *(if your power contract contains a power-factor or kva-demand clause)*

"With a total expenditure of $13,000 our savings have averaged $1000 monthly."

. . . An automobile manufacturer, Detroit

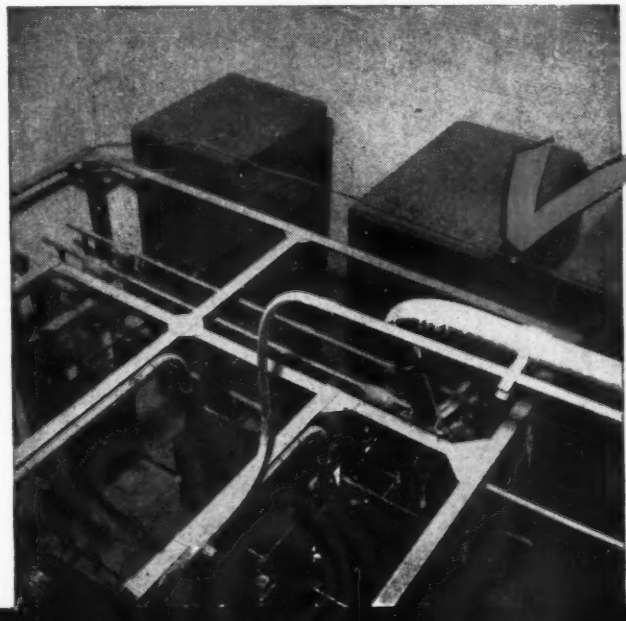
THEY SAVE MATERIAL

"Almost 50,000 pounds of critical material would have been required if new circuits had been added. With capacitors, only 4000 pounds of material was needed."

. . . A Midwestern paper manufacturer

THEY EASE RECONVERSION PROBLEMS

Capacitor equipments are assemblies of small, compact, individual units, easy to connect or disconnect, easily regrouped and moved to new locations—to serve your peacetime loads. They may make it unnecessary for you to relocate other heavier electric equipment.



PYRANOL CAPACITORS

◀**CAPACITORS AUTOMATICALLY SWITCHED**—The Allied Mills, Inc., Buffalo, N. Y., put in three banks of Pyranol capacitors totaling 200 kva to correct a bad power-factor condition that affected 1136 hp of motors. One bank has a hand-operated switch; the two other banks have automatic switches, actuated by a current transformer and relays, which connect or disconnect the capacitors with the rise and fall in the kva demand.

If your plant's power system is fully loaded—or overloaded—and is operating at low power factor, ask your G-E representative to estimate how much your circuit capacity can be increased by Pyranol capacitors. Or write for Bulletin GEA-77. General Electric Company, Schenectady 5, N. Y.

**Reg. U.S. Pat. Off.*

BUY WAR BONDS

GENERAL ELECTRIC

TO HELP YOU MEET

COMBUSTION ENGINEERING

VU

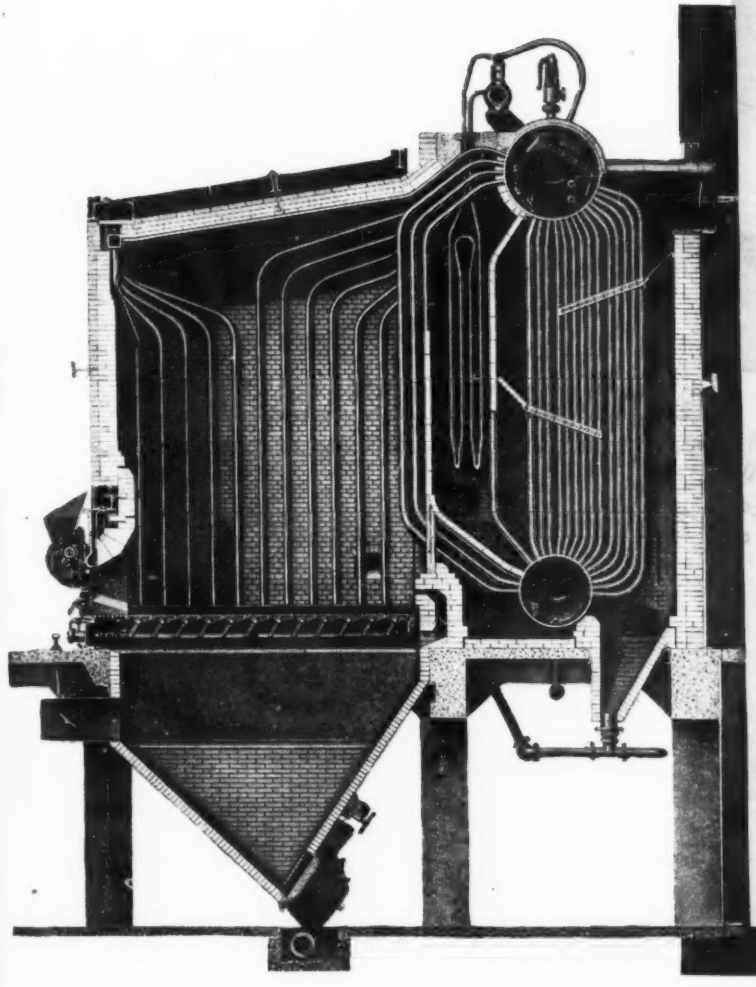
STEAM GENERATOR

FOR USE WITH
PULVERIZED COAL,
OIL, GAS OR COMBINATIONS
OF THESE FUELS

There may still be many unanswered questions as to post-war business conditions, but there's one thing of which we can be certain — competition is going to be keener than ever, and low-cost production will therefore be of the utmost importance. Steam for heating, power and process enters substantially into the cost of virtually all products — from gadgets to heavy equipment, yet the vast majority of American manufacturers are still handicapped by high steam costs. Here, then, is a big opportunity for alert engineers to make a real contribution to the lower production costs their managements will need to meet post-war competition. To such engineers we suggest investigation of the reduced steam costs obtainable with Combustion Engineering's Type VU Steam Generator.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEA

POST-WAR COMPETITION



COMBUSTION ENGINEERING

VU

STEAM GENERATOR

FOR USE WITH ANY TYPE OF STOKER

ALSO OIL OR GAS

Reasons for the Economy of this C-E Unit

There are two principal reasons for the economy of the VU Steam Generator:

- **HIGH EFFICIENCY:** VU Units in the smaller capacity range, stoker fired and without heat recovery equipment, operate at efficiencies in the neighborhood of 80 per cent, depending on type of stoker and fuel. The larger VU Units with heat recovery equipment operate at efficiencies up to 88 per cent. These are not test efficiencies, nor optimistic claims; they are figures taken from average monthly records of users.

- **LOW MAINTENANCE AND OUTAGE:** Ability to stay on the line for long periods means low maintenance and avoidance of serious outage losses. Many users of VU Units have reported exceptional service records. Here are a few recent ones: "works around the clock, 7 days a week for months on end until we shut down for scheduled inspection" . . . "in continuous operation for 9 months since first placed in service" . . . "two units, on the line 97% of all the time for a year."

Further evidence of the efficient, economical performance of VU Units is their wide acceptance throughout the world. Not only are there hundreds of installations in the United States and Canada, but also in Arabia, China, Russia and other remote regions where equipment *must* be good because service engineers are not available.

VU Units will give you the overall economy you will need to meet post-war competition coupled with high fuel costs. Then you will find that the best equipment you can get is the least expensive. A-825

Combustion C-E Engineering

200 MADISON AVENUE NEW YORK 16, N. Y.

FLAMENOL Showed No Aging

THIS FLAMENOL CABLE, after six years' exposure to weather, without covering, is as good as new. Note the glossy, uncracked surface.
THIS OIL-BASE, RUBBER-INSULATED cable, exposed to identical conditions over the same period, is dull and badly cracked.
THIS MINERAL-BASE, RUBBER-INSULATED cable, after the same exposure, shows the same dullness and cracking as the oil-base rubber insulation.

IN THIS SIX-YEAR TEST UNDER FLORIDA'S SUN

Back in 1937, a large railroad company operating in the South, where climate is particularly unkind to cable insulations, decided to test the stamina of various types of insulation. Two of the samples tested were the usual rubber-insulated types; the third was Flamenol. None was protected by braid or other covering, so that insulation was exposed directly to sun and weather.

In 1943, after six years of continuous exposure, the three samples were taken down, and examined. The dramatically conclusive results are shown in the photographs above. Only Flamenol had stayed young!

FLAMENOL RESISTS ACID, ALKALI, OIL, AND WATER

Before the war, millions of feet of Flamenol cable had already been installed in factories, oil refineries, mines and railroads; places where its ability to resist most solvents and heat made it a "must." In the future, this proved-performance cable will find even wider fields of application in reducing maintenance costs and minimizing shut-downs due to insulation failure.

Note, at the right, Flamenol's operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Company, Schenectady 5, N. Y.*

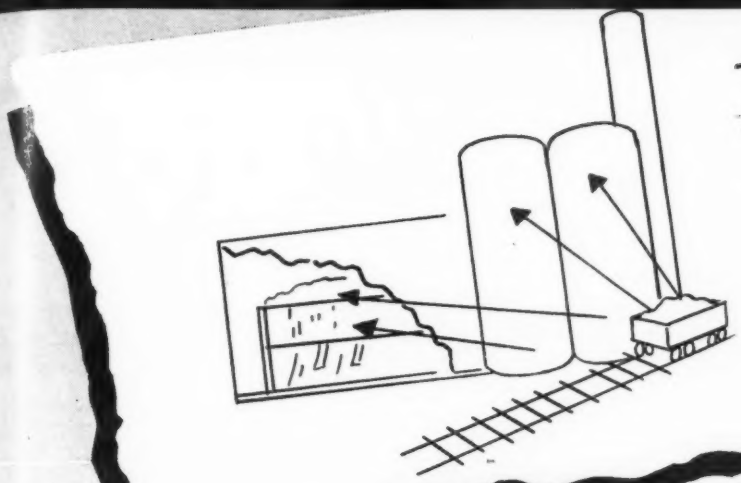
11 OUTSTANDING ADVANTAGES OF *FLAMENOL*

1. **FLAME RESISTANCE**—*will not support combustion.*
2. **CORROSION RESISTANCE**—*immune to action of oils, acids and alkalis.*
3. **SUPER-AGING**—*will not oxidize, therefore highly resistant to sunlight and weathering.*
4. **EXCELLENT PHYSICAL PROPERTIES**—*minimum tensile strength, 1,500 lb per sq in.; minimum elongation, 100 per cent.*
5. **CONSTANT DIELECTRIC STRENGTH**—*retained at about 720 volts per mil under severe operating conditions.*
6. **SMALL DIAMETER**—*saves space, and speeds wiring.*
7. **SMOOTH SURFACE**—*facilitates pulling through conduit.*
8. **VARIETY OF COLORS**—*simplifies circuit tracing.*
9. **FREE STRIPPING**—*steps up installation, avoids weakening nicks on conductors.*
10. **WIDE RANGE OF CONSTRUCTIONS**—*aids selection for special applications.*
11. **SELF-PROTECTING FINISH**—*eliminates need for braid covering, saves space and weight.*

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

502-47-1200



The Problem—

To move coal from cars to storage and reclaim for boiler room use.

HOW S-A ENGINEERS *Solved the Problem*

Here's a typical example of how coal handling at power plants can be greatly simplified — and at the same time made more efficient.

A coal handling system consisting of three REDLERS accomplished the entire job, from track hopper to boiler stoker.

The L-shaped REDLER Conveyor—Elevator (shown dotted in the photo) is the key factor to efficient, low-cost handling in this plant.

The need for a separate feeder under the track hopper was entirely eliminated and not only does the REDLER convey and elevate incoming coal from railroad cars to twin storage silos, but the *same unit* also reclaims coal from either or both silos for delivery to the boiler room via two horizontal REDLER conveyors located on the roof.

Simplicity of arrangement, coupled with compactness and dust-tight handling show what can be done when the *right equipment* and the *right method* are brought to bear on a specific problem. For further information on coal handling equipment, write us today.

STEPHEN S-A ADAMSON MFG. CO.

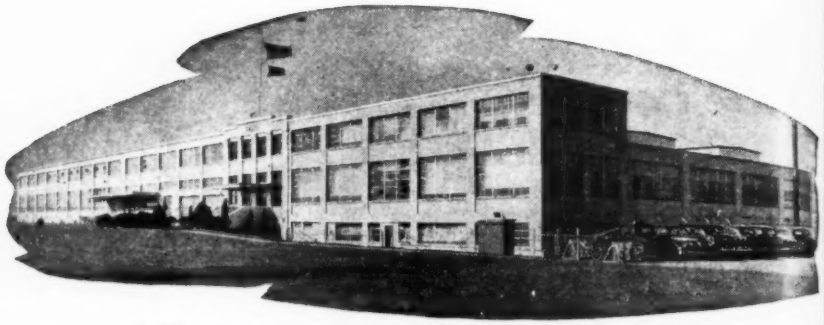
5 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

Boiler Capacity Up . . . Fuel Cost Down

WHIPPLE JACOBS, *President*
Belden Manufacturing Company



Exterior view of the Belden Manufacturing Company, Richmond, Indiana, well known makers of insulated copper wire, cable and cordage.

IRON FIREMAN STOKER Saves Over $3000 a Year at Belden Manufacturing Co.

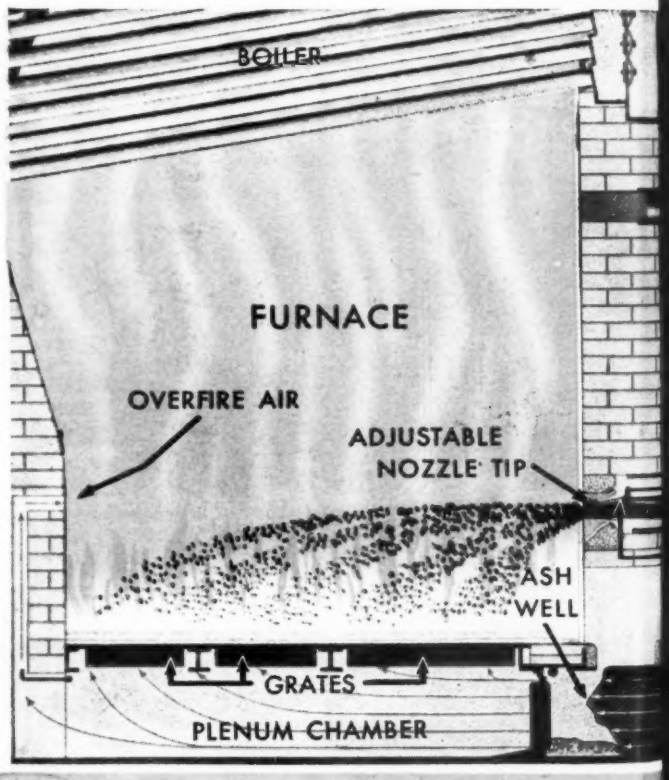
★ "In addition to providing a required increase in the capacity of our old boilers, we have reduced operating costs by $3,293 annually," reports D. D. McQuiston of the Engineering Department of Belden Manufacturing Company.

The Iron Fireman Pneumatic Spreader stoker model as used by Belden permits the use of local and lower cost coal, a vital advantage now when the transportation bottleneck presents serious difficulties. This greater efficiency and lower fuel costs are typical of thousands of war production plants that have changed to automatic coal firing.

Convert to Automatic Coal Firing Now

No priorities are needed now for you to obtain the labor and fuel saving Iron Fireman Automatic Coal Stoker.

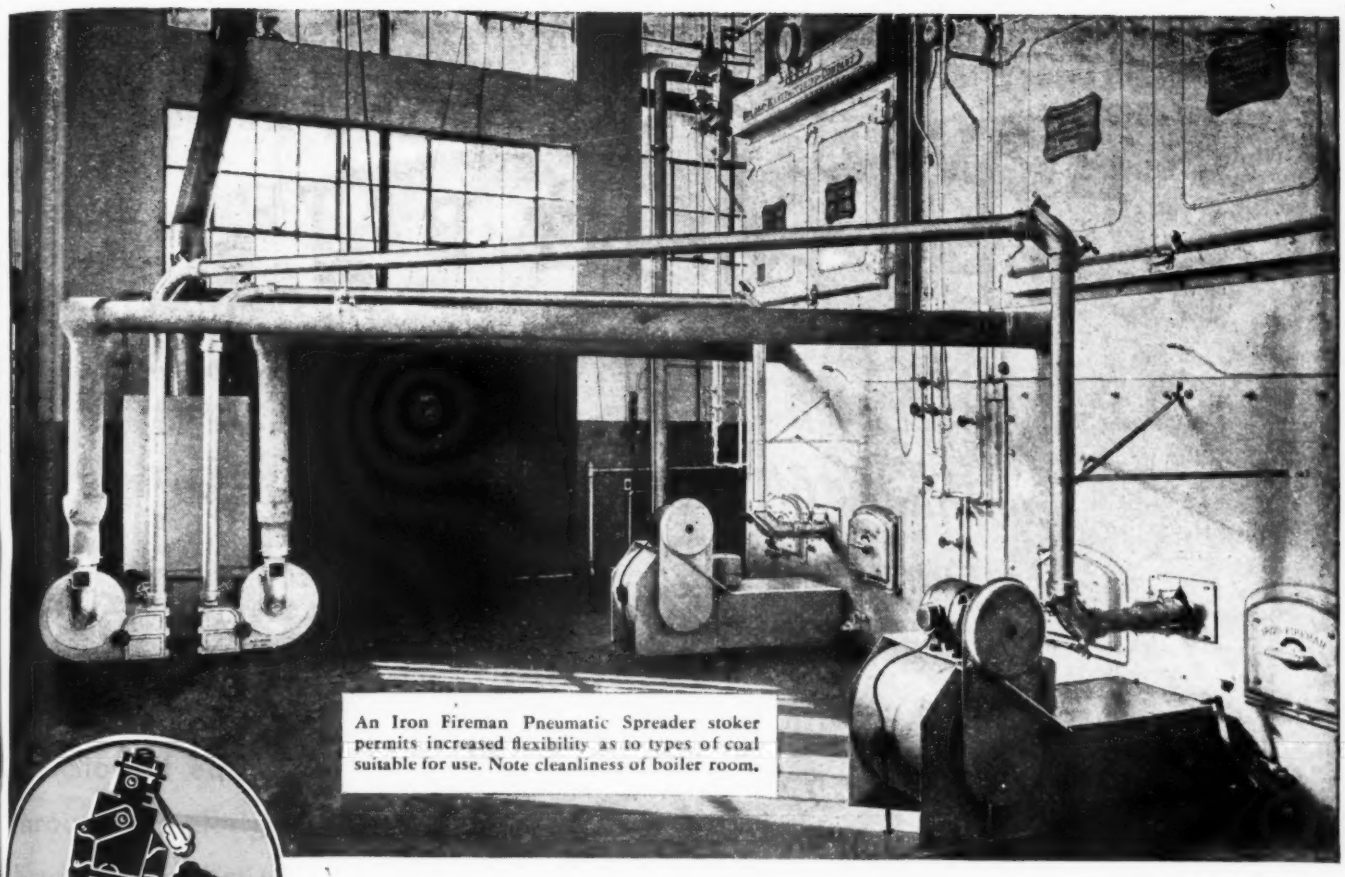
Phone, wire or write Iron Fireman Manufacturing Company, 3840 West 106th Street, Cleveland, Ohio.



IRON FIREMAN

THE IRON FIREMAN

Automatic Coal Stokers



An Iron Fireman Pneumatic Spreader stoker permits increased flexibility as to types of coal suitable for use. Note cleanliness of boiler room.

THE IRON FIREMAN

PREHEATED AIR PIPE

Coal Conveying Pipe

Nozzle Adjuster

Coal Nozzle

Forced Draft Fan Motor

Transfer Housing and Conveyor Fan Housing

Conveyor Fan Motor

Connection for Combustion Control

FORCED DRAFT FAN

COAL HOPPER

BUNKER-FEED MODELS

Coal is conveyed automatically from the bunker to the boiler

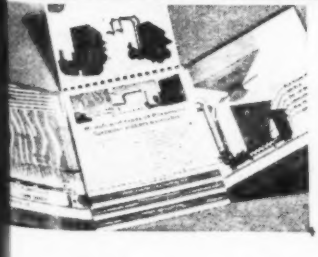
Coal Conveyor Pipe

Worm Housing Cleanout

Feed Worm

Coal Feed Motor

Transmission

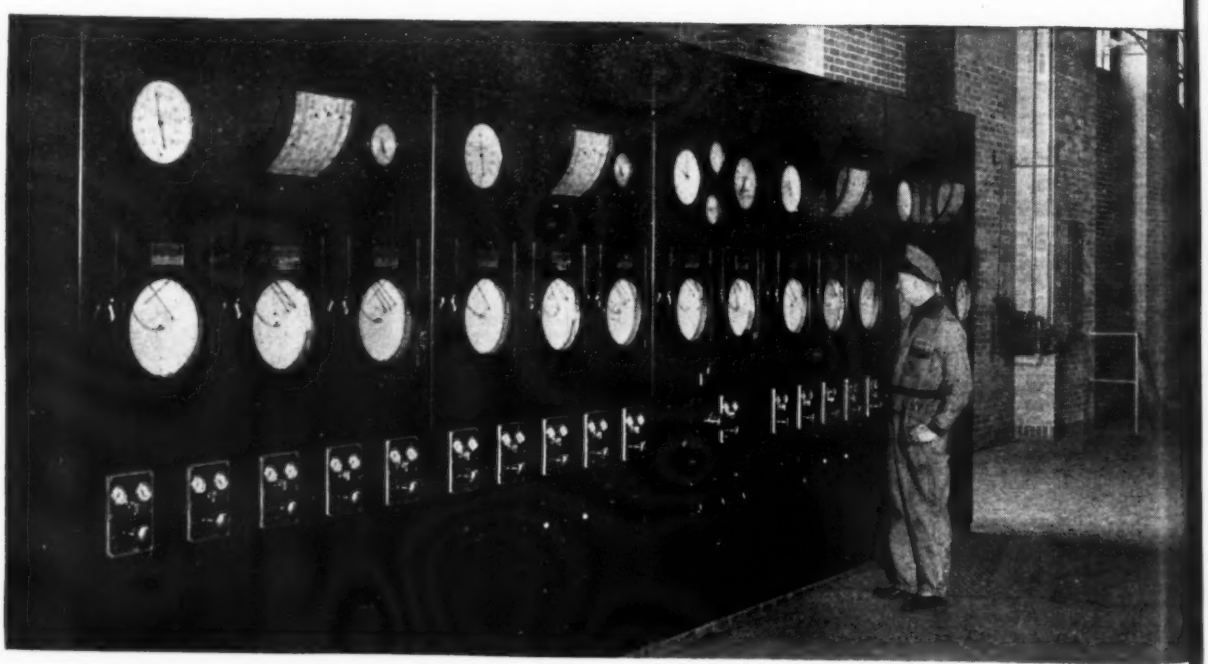


FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3840 W. 106th Street, Cleveland, Ohio.

HOW DOES YOUR BOILER PLANT RATE ON *THESE* POINTS?

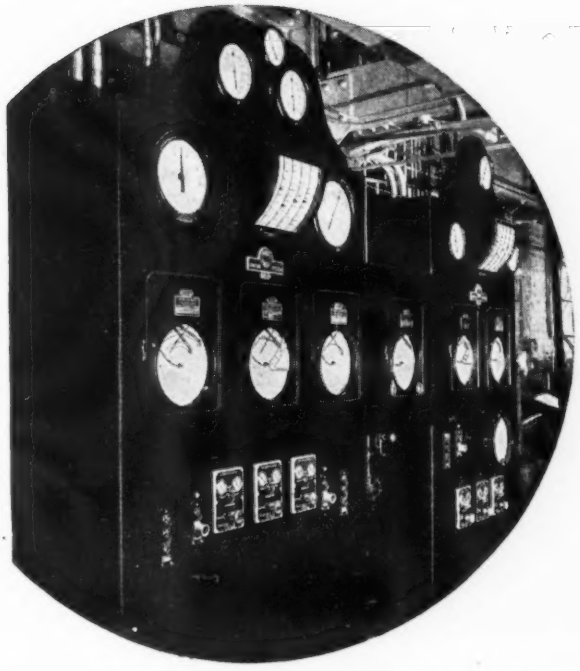
1. Continuity of service.
2. Evaporation ratio.
3. Safety of operation.
4. Peak steaming capacity.
5. Utilization of available manpower.



This Bailey Boiler Control Panel continuously maintains Optimum Performance in a central heating plant.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEA



Installation of Bailey Boiler Meters and Boiler Control in an Eastern paper mill. This equipment automatically functions to maintain daily boiler performance at the same high standards obtained during boiler tests.

★ Optimum performance may be secured on all these counts by applying engineered instrumentation in the form of Bailey Boiler Meters and Control.

Bailey Boiler Meters and Control are specified and applied to the individual requirements of each plant. Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation, and final adjustment on the job.

Engineering work in the user's plant is done by Bailey Field Engineers, who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over thirty industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has a background of combustion engineering "know-how" which has been accumulated through years of service. He has at his command the results of thousands of tests on boiler installations covering a wide range of fuels, furnaces, and fuel burning equipment. He has more to offer than meters and controllers. He is primarily interested in helping you to secure optimum operating conditions in your plant. G-24

BAILEY METER COMPANY
1036 IVANHOE ROAD, CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

e Complete Combustion Control System

ROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

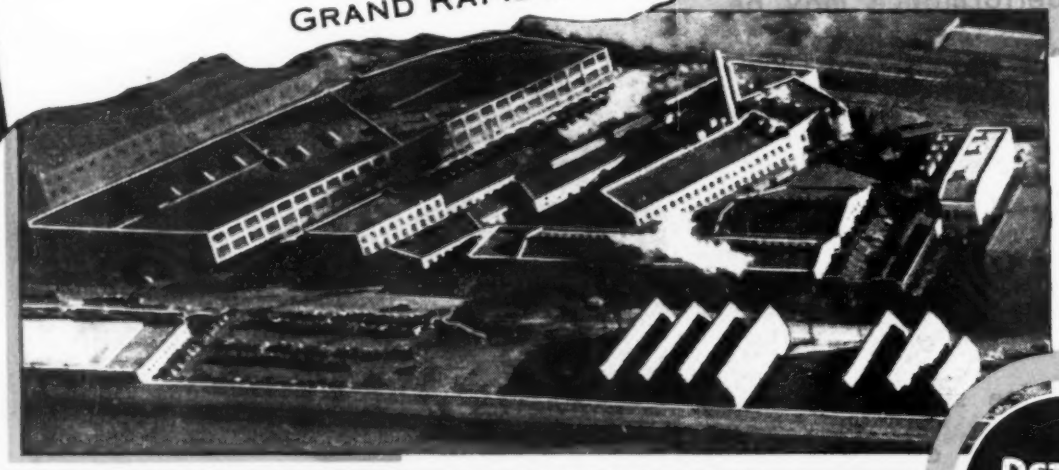
AMERICAN BOX BOARD COMPANY

FOLDING PAPER BOXES
FIBRE SHIPPING CONTAINERS
CORRUGATED SHIPPING CONTAINERS

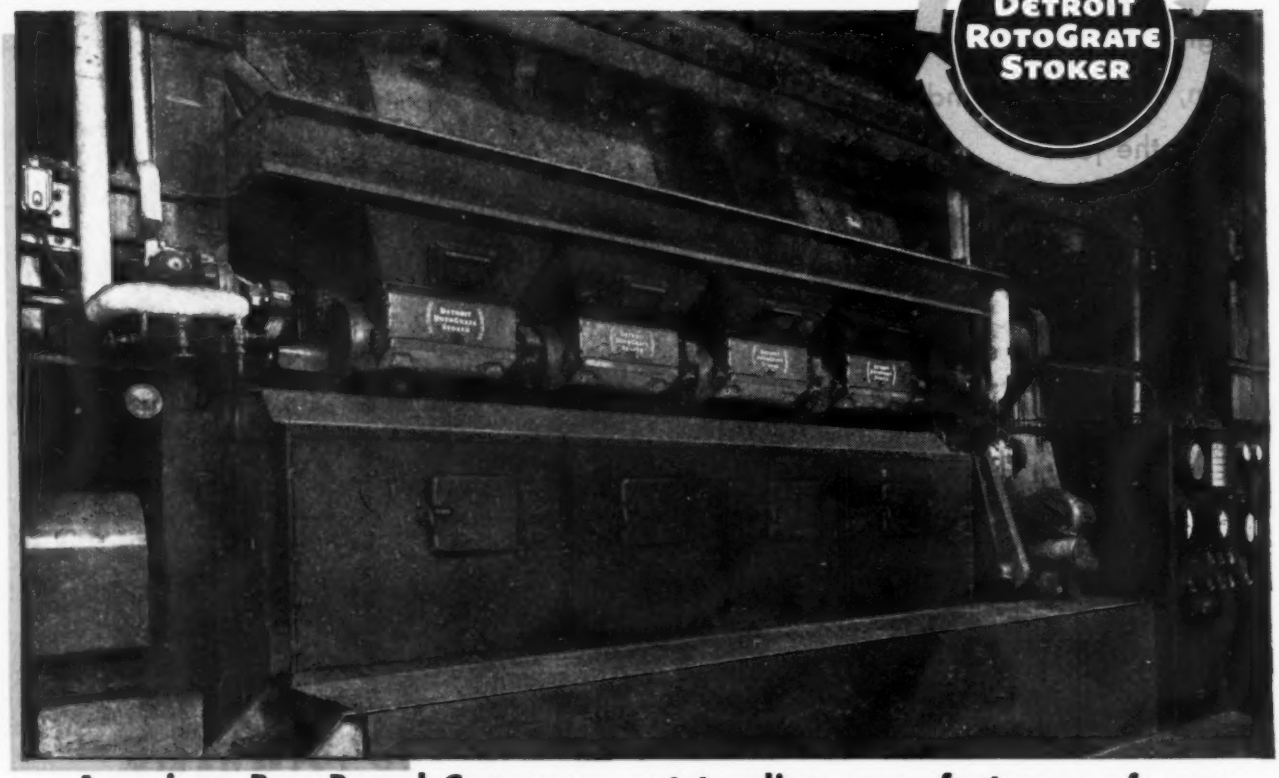
STRAW BOARD
SUIT BOX BOARDS
HIGH TEST LINERS AND CHIP

GRAND RAPIDS, MICH.

REPORTS



DETROIT ROTOGRATE STOKER



American Box Board Company, outstanding manufacturers of container board and containers, use a RotoGrate Stoker applied to a three drum steam generator, with economizer, air heater and superheater, continuous rated capacity 110,000 pounds of steam per hour. RotoGrate reported carrying entire plant load.

DETROIT STOKER COMPANY

OVER 86% EFFICIENCY

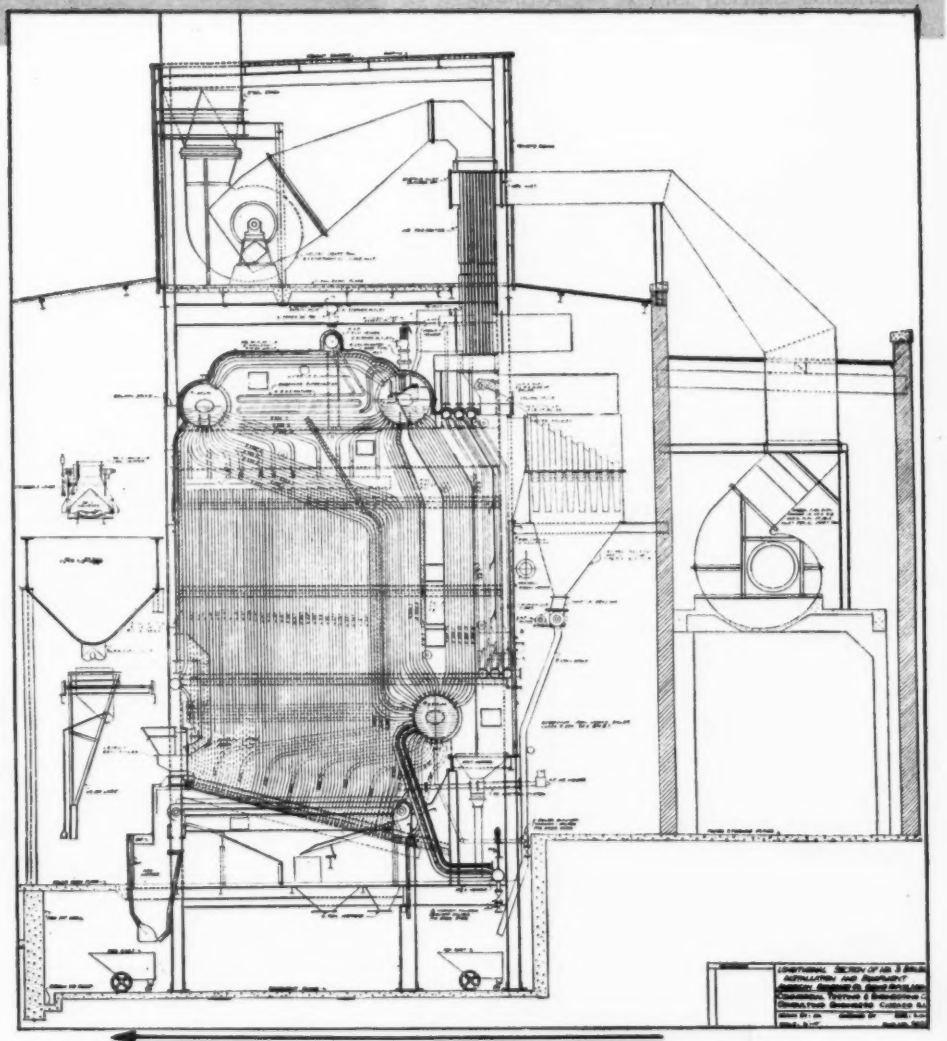
DETROIT ROTOGRATE STOKER

Steam Generator and RotoGrate Stoker:

110,000# hr. continuous capacity • 200# pressure • 490° F. steam temperature • 230° F. Feed Water temperature 240° F. air for combustion.

Heating Surfaces:

Boiler	**11900 sq. ft.**
Water walls	**2597 sq. ft.**
Economizer	**3040 sq. ft.**
Superheater	**1220 sq. ft.**
Air heater	**6010 sq. ft.**



CONTINUOUSLY CLEANING GRATE MOVES FORWARD

Detroit RotoGrate permits high burning rates with fuels of either high or low ash content. *Continuously Cleaning* with a *Forward Moving Grate.* Quickly responds to load changes with no loss in production, due to corresponding changes in fuel and air supply. Overfire air is proportioned to undergrate air, producing furnace turbulence and thorough mixing of the products of combustion, with high CO_2 and correspondingly high efficiency at all ratings.

Write for Bulletin

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

then he said to himself

"I'M SITTING TIGHT"

REPLYING to America's early proposals and assurances that the United Nations had no designs on Spanish territory, Dictator Francisco Franco defended his neutrality with:

> "I will avoid anything which might disturb our relations in any of their aspects."

Sitting tight in any business is one of the easiest things a man can do.

The only trouble is that in this era of quick advances, sitting tight doesn't get one anywhere—but down—and fast.

And when the dust of the passing parade clears—it's a long, plodding process to catch up.

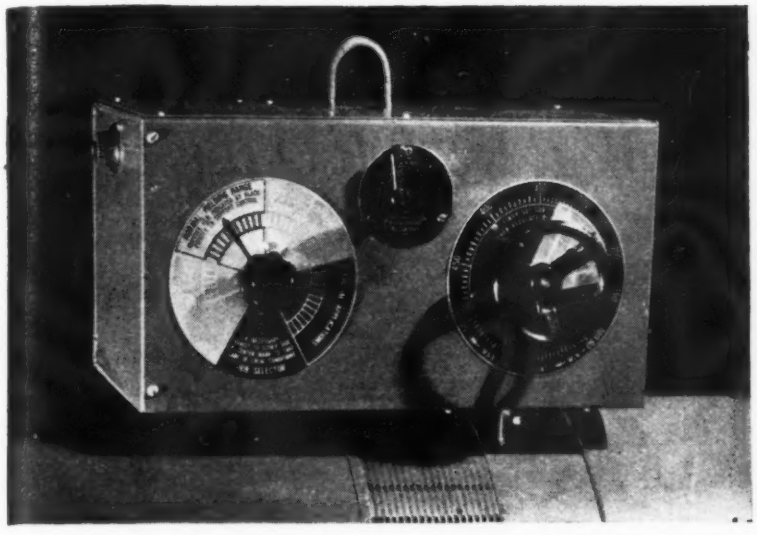
We see it well expressed in many "Stand pat" companies now making *no* plans for improving their welding methods—either in new production techniques or the latest welding equipment.

And others . . .

"SITTING TIGHT," *he says*

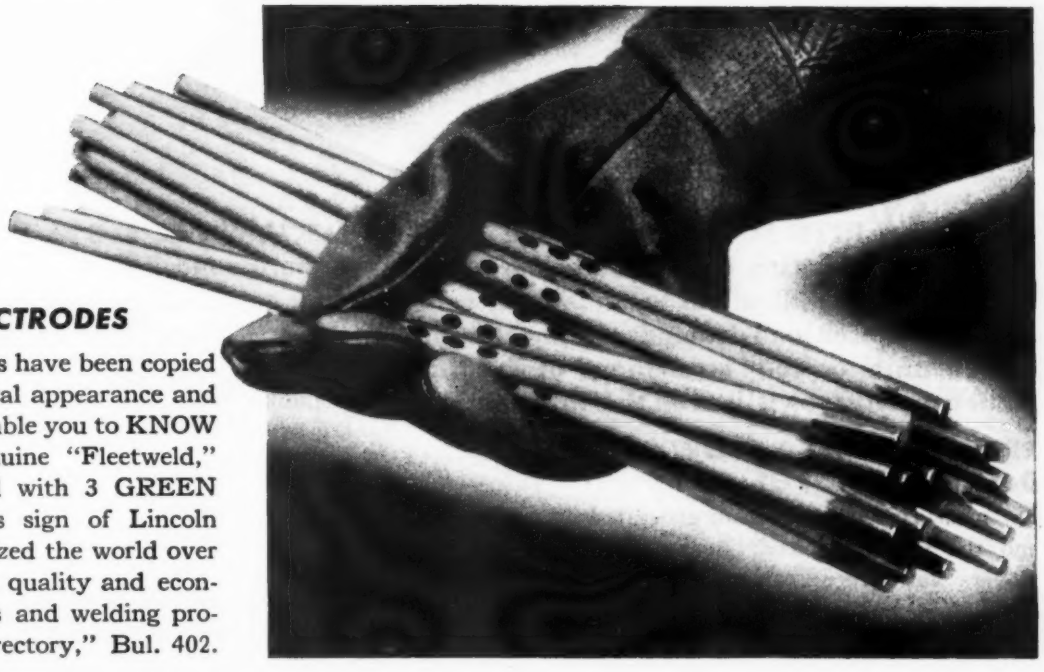
Look, Francisco . . . here is the wherewithal to step out in front with Arc Welding:

THE TOOLS FOR NON-STANDPATTERS



"SHIELD-ARC" WELDER

The "Job Selector" of the Lincoln "Shield-Arc" Welder permits selection of the TYPE of welding arc . . . a predetermined welding characteristic . . . to match the job. Its Current Control provides any desired amperage over a wide range. Both selectors are Self-Indicating for KNOWN results . . . unmatched speed, ease and economy of welding. The "Shield-Arc" is recognized the world over for its superiority 32 ways . . . described fully in Bul. 412.



"FLEETWELD" ELECTRODES

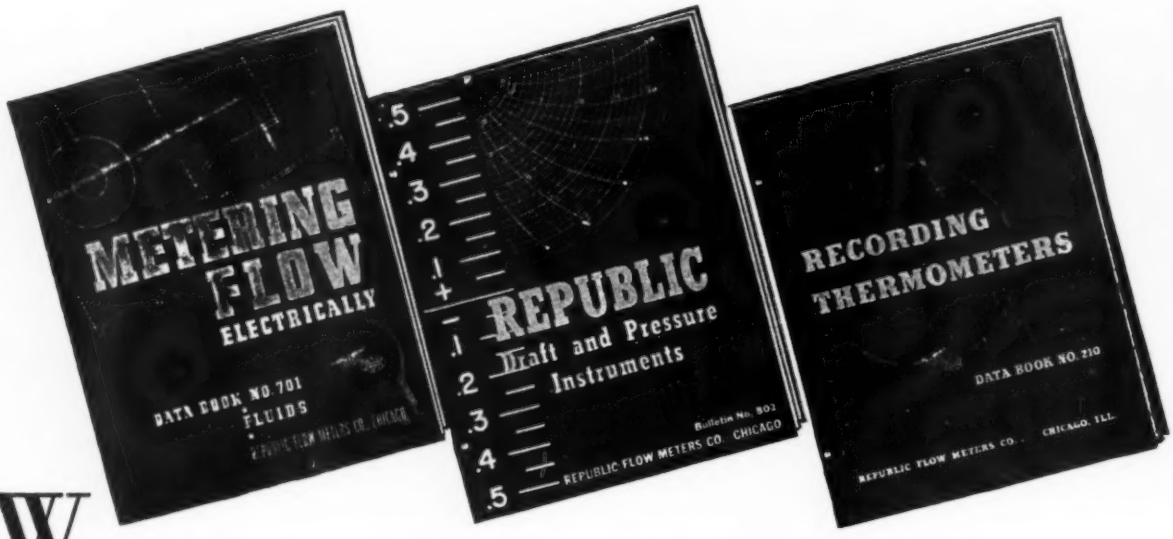
These world favorites have been copied extensively as to general appearance and color of coating. To enable you to KNOW that you get the genuine "Fleetweld," they now are marked with 3 GREEN DOTS. Look for this sign of Lincoln Electrodes . . . recognized the world over for their superiority in quality and economy. Complete details and welding procedures in the "Weldirectory," Bul. 402.

THE LINCOLN ELECTRIC COMPANY • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

THESE
Data Books
WILL HELP YOU
SOLVE YOUR POWER PROBLEMS



WRITE for these data books now! They are filled with important power plant data generally difficult to locate. When your increased power load demands the installation of new units or the "stretching" of existing plant capacity, you will need this information.

REMOTE READING FLOW METERS — Data Book No. 701

For measuring flow of steam generated by each boiler and the total produced; steam consumed by prime movers and process steam consuming units; water supplied to boilers and pumped to processes; rate of generation, distribution and consumption of natural gas, coke oven gas, compressed air and the like; flow of fuel oil, brine, black liquor and so on; the Republic electrical type flow meter with remote reading instruments, as described in this book, is available.

MECHANICAL FLOW METERS — Bulletins No. 110 and No. 311

When it is desired to measure flow of steam, water, gas, air or oil for the same purposes as outlined above but where remote registration is not required, the Republic mechanical meters described in these books are available.

DRAFT AND PRESSURE INSTRUMENTS — Bulletin No. 802

Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic indicators and recorders, described in detail in this bulletin, are supplied in any desired combination for all ranges encountered in furnace operation.

RECORDING THERMOMETERS — Data Book No. 210

Measurements of temperature of flue gas, temperatures in vats or tanks, pipe lines, refrigeration systems, ovens, kilns or ducts and so on, are vital in maintaining highest capacity and efficiency in power plant and process equipment. Republic recording thermometers for this service are described in this data book.

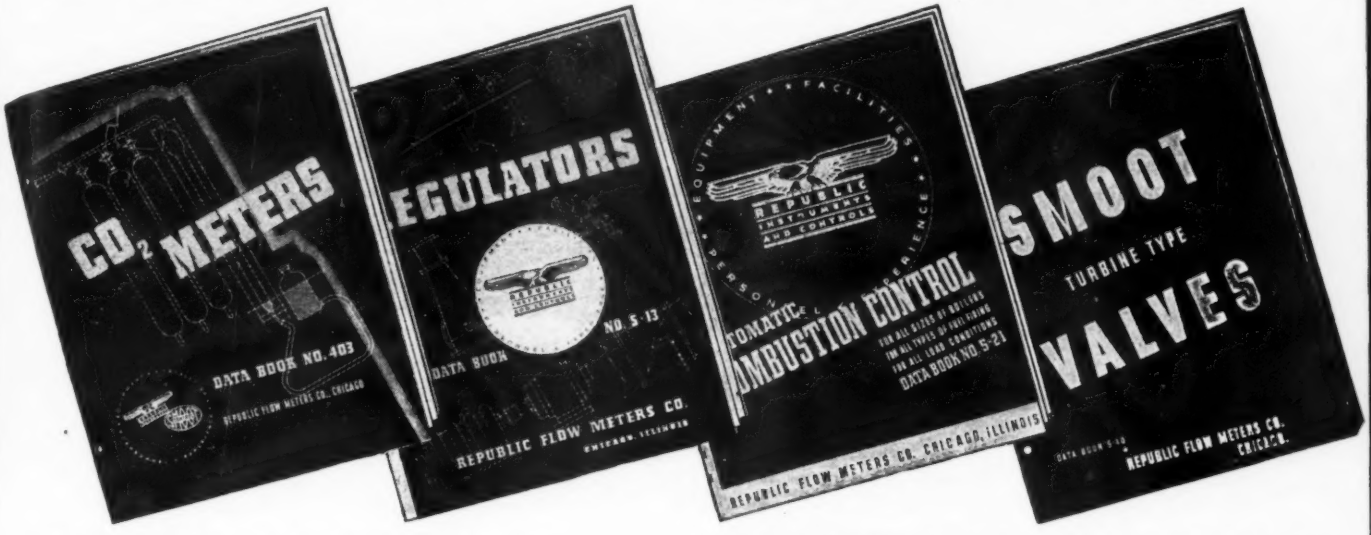
CO_2 METERS — Data Book No. 403

For every fuel and boiler, there is a definite percentage of CO_2 in the flue gas that will assure highest combustion efficiency. The CO_2 meter is the most practical method of determining combustion efficiency. The construction and operation of the Republic CO_2 meter are described in detail in this book.

Republic-Smoot automatic combustion control systems are built for all sizes of boilers, all types of fuel firing and all load conditions, as described in this book, which includes detailed installation reports giving performance data on outstanding power plants.

REGULATING VALVES — Data Book No. S-40

In any plant generating high-pressure, high-temperature steam, there are key valves doing tough jobs in controlling flows or pressures on which vital operations depend — pressure reducing valves co-ordinating high and low pressure steam systems, feedwater valves on 1500 lb. boilers. For such tough jobs, where responsibility, long life and accurate regulation count most and failure must not occur, the Republic-Smoot valves described in this bulletin have been designed.



REGULATORS — Data Book No. S-13

Control of rate of flow of liquids and gases, level of liquids, speed of turbines, engines and motors and proportions between variable pressures and flows must be accurate if maximum plant efficiency is to be attained. These factors are controlled by operation of valves, dampers, rheostats, etc. For sensitive, fast, stable and powerful automatic control of these devices, the Republic-Smoot regulator has been developed. Its construction, operation and applications are described in this book.

AUTOMATIC COMBUSTION CONTROLS — Data Book No. S-21

Boilers must produce maximum steam output at maximum efficiency. That means constant steam pressure, maximum combustion efficiency, constant and correct furnace draft, desired load division among boilers.

DESUPERHEATERS — Data Book No. S-35

In the modern power plant, steam temperatures in interconnected systems — topping turbine bypasses, tie lines, turbine exhaust lines and process steam headers — must be accurately controlled by desuperheaters. For such exacting services, the Republic-Smoot desuperheaters described in this book are employed.

★ ★ ★ ★

Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant. Your inquiries will involve no obligation on your part.

Republic Flow Meters Co.

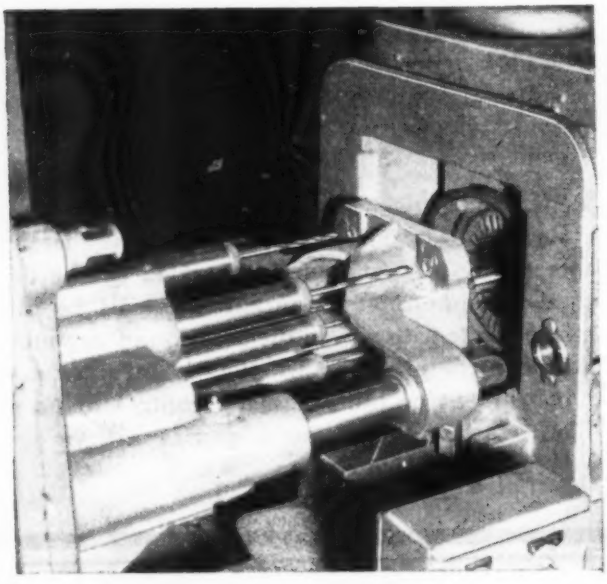
2222 Diversey Parkway • Chicago, Illinois

BLESSED BOLT HOLES

It's a blessing to electricians and maintenance men when bolt holes in motor end shields and frames are exactly in line, and mounting holes in the feet are uniformly and accurately positioned. Installation is easier. Interchanging of motors, rotating of end shields, and reversal of stators are all more quickly accomplished. Tight fits are obtained without forcing. Bearing alignment is insured, internal strains are avoided. During the war period, jig-fixture uniformity maintained in machining, drilling, and tapping Tri-Clad motor frames has saved thousands of man-hours of installation and servicing.

End shields are easily rotated for inverted motor mounting.

JIGS AND FIXTURES OF ADVANCED DESIGN MEAN CLOSE FITS IN TRI-CLAD MOTORS



Specially built production equipment, as well as test apparatus, helps build Tri-Clad motors with close fits and clearances. Here, all bolt holes in the frame are drilled in a single operation within a rigid fixture that insures accurate positioning. In the finished motor, this results in more accurate shaft alignment, smoother operation, longer bearing life. General Electric's high-volume motor production permits tooling up for high precision without increasing the cost to you. *General Electric Co., Schenectady 5, N.Y.*

Frame-drilling operation at G.E.'s Lynn (Mass.) Works.

GENERAL ELECTRIC

750-249-5960

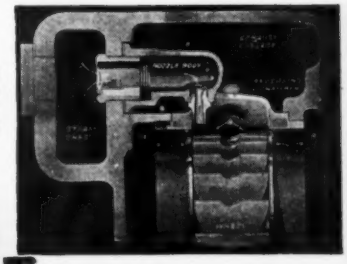
TRI-CLAD MOTORS

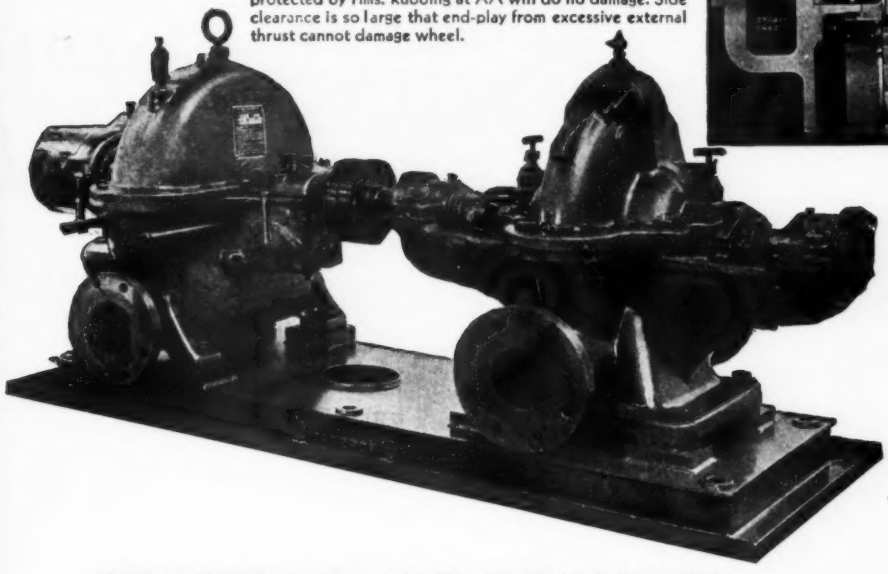
Buy all the BONDS you can—*and keep all you buy.*

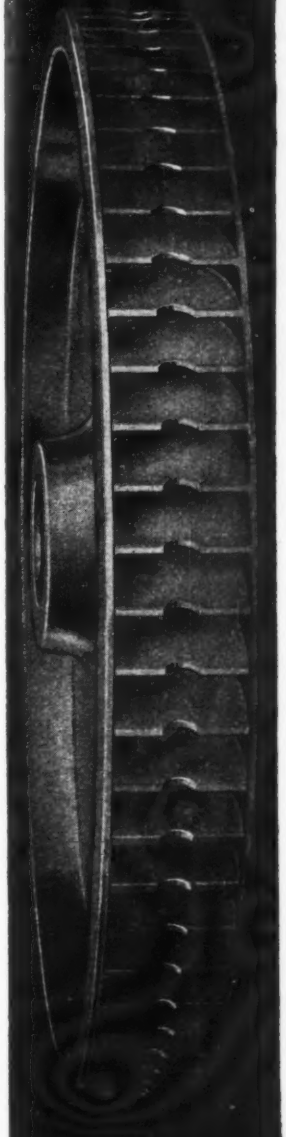
TERRY

DIAGRAM SHOWING WHEEL CLEARANCES

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.







GENEROUS BLADE CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

Details of this durable turbine are discussed in Bulletin S-116.
A request on your business letterhead will bring a copy.

T-1155

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

"Not a Single Main Line Fuse Failure in Three Years—*Since We Switched to BUSS Super-Lag*"

Says **MR. C. E. TUFTE, President Elkhart-Moraine Sand & Gravel Co. • Elkhart Lake, Wisconsin**

"We had been having too much trouble on our main circuit, protected by 600 ampere, 440 volt renewable fuses. On an average of once a week this circuit was shut down because fuses went out due to temporary overloads. An extra heavy load in crushers, or the simultaneous starting of several motors would cause a temporary overload and a fuse would blow. This unnecessary blowing of fuses produced a very aggravating situation—left workers idle—shut down production—and lost money for us.

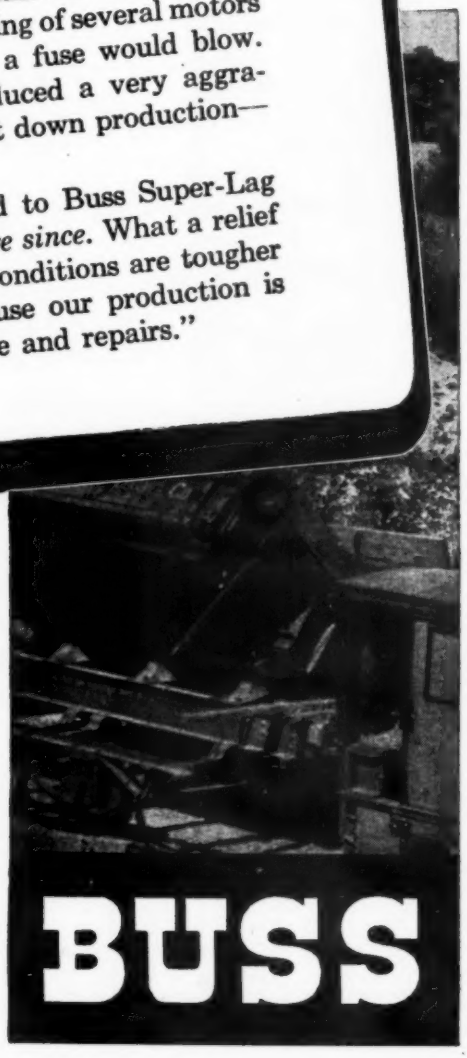
"Then, three years ago, we switched to Buss Super-Lag fuses—*and we haven't had a single failure since.* What a relief that has been. And today's operating conditions are tougher than they were three years ago, because our production is greater, with less time for maintenance and repairs."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES
in the design of the FUSE-CASE help make it possible.

and

The SUPER-LAG
development in the FUSE-LINK completes the job.



BUSS

You, too, can get relief from production breakdowns due to fuse failures. The solution to your problem is just as easy as it was for Mr. C. E. Tufte at Elkhart-Moraine Sand & Gravel Co. BUSS Super-Lag fuses provide the extra-time lag to protect against harmless surges, yet give complete and adequate protection.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here Is Why BUSS Fuses Greatly Reduce or Entirely Prevent Needless Blows

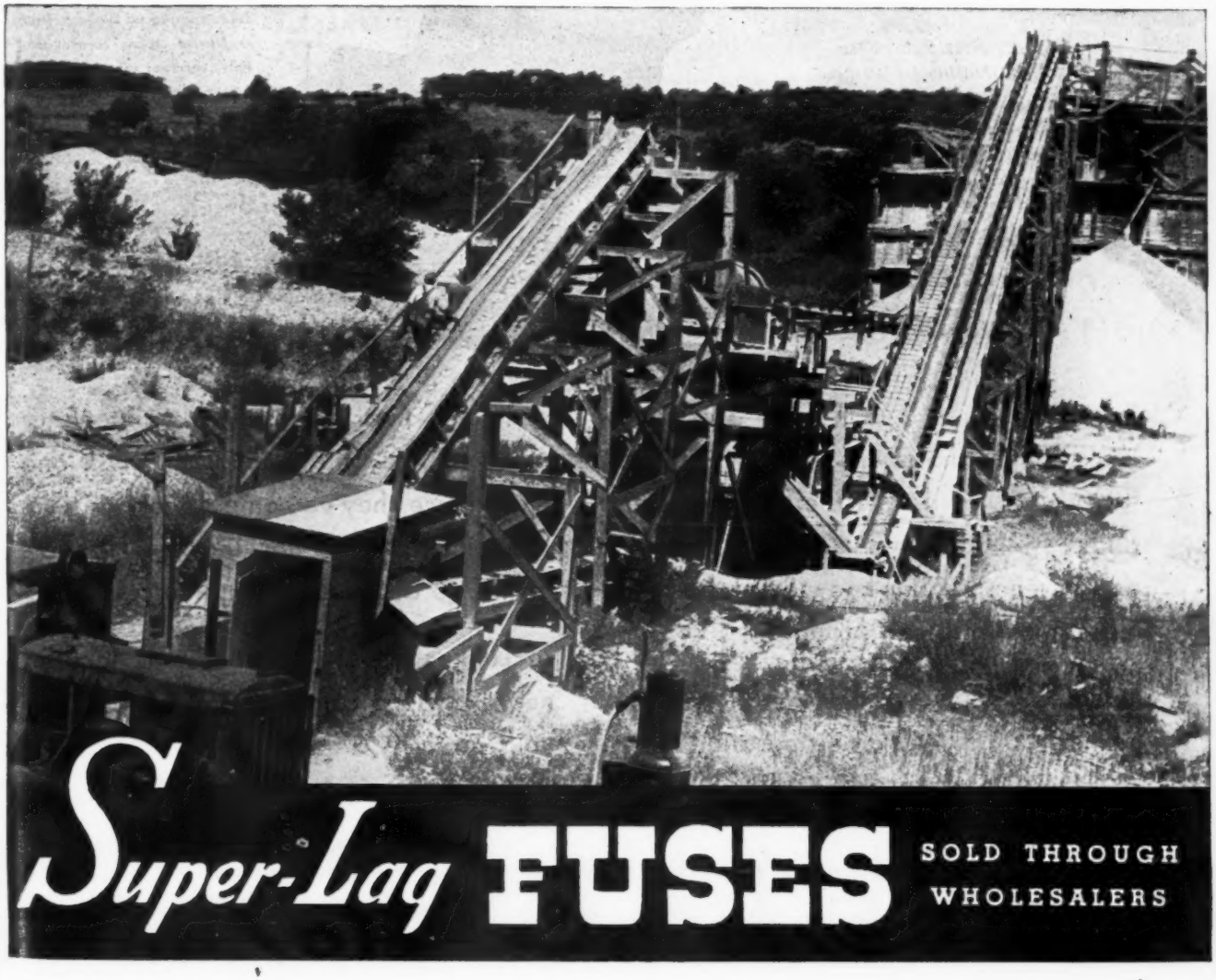
The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

How to solve the "shutdown" problem

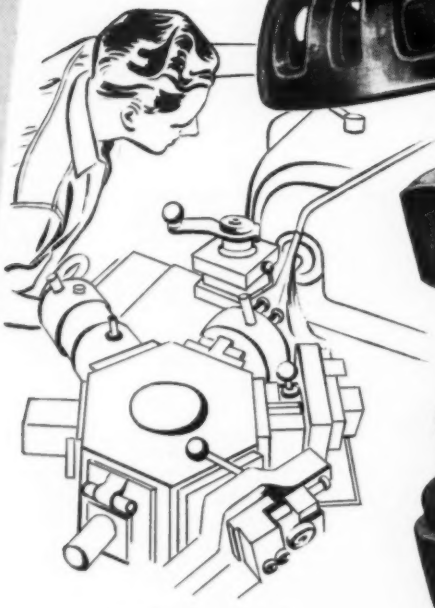
Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.
Division McGraw Electric Company



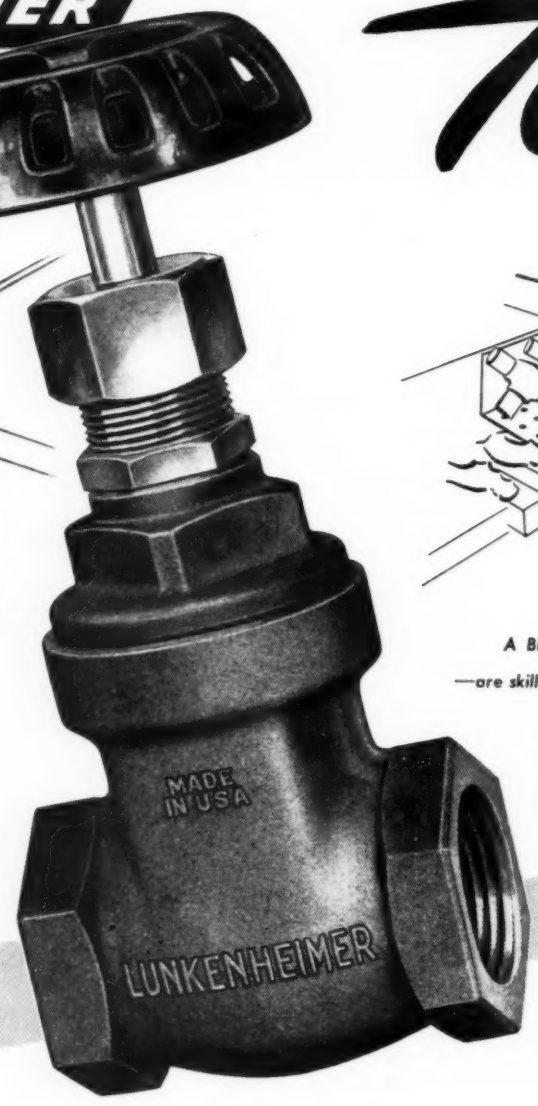
LUNKENHEIMER

TOP



HE'S INTERESTED IN TEN-THOUSANDTHS OF AN INCH

This man is finishing a part, working to extremely close tolerances. If parts do not measure up to the stringent requirement for accuracy, they never enter a Lunkenheimer Valve.



A BIG "PLUS" IN MOLDING

—are skilled men and modern machinery. This experienced Lunkenheimer craftsman cleans cores carefully, removes all parting line edges, assuring smooth, clean castings on the inside.

Fig. 2129
125 lb. S.P. Bronze Gate
Wedge Disc, Non-Rising Stem

For over three quarters of a century, Lunkenheimer has specialized in the manufacture of valves . . . the most efficient and dependable valves which scientific design, engineering knowledge, and fine mechanical skill can produce.

"Quality" is a living ideal at Lunkenheimer—guiding every operation from design to final assembly. Maintenance men well know that quality. Through long experience they've come to rely on Lunkenheimer Valves for the best in performance at lowest maintenance cost.

A Lunkenheimer Distributor is located near you. His complete facilities are at your service.

LUNKENHEIMER

PERFORMANCE

COMES FROM SUPERIOR

"Know How!"

THE RESULT OF LONG ACCUMULATED EXPERIENCE, PLUS QUALITY STANDARDS RIGIDLY MAINTAINED

Fig. 2125
125 lb. S.P. Bronze Gate
Double Disc, Rising Stem

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 7

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES—125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS.

VALVES

Simplicity in Design
MEANS LOWER COST MAINTENANCE

How to tube a heat exchanger for new high temperatures ...new high pressures

If you were to look inside the feedwater heaters of the latest high pressure power plants, you would see how one of the major problems of high temperature–high pressure operation was solved in constructing these units.

The problem was to find tubing material that could withstand higher temperatures and higher pressures than had ever been tried before.

The tubing had to be stronger at elevated temperatures. It had to be corrosion-resistant to maintain a smooth surface and prevent accumulation of sludge and salt deposits. It had to have good heat-transfer properties. It had to be hard and tough to resist erosive wear. And it had to be ductile, so that it could be readily expanded into tight head connections.

In checking over possible materials, three groups of engineers, working independently on this problem, came out with the same answer: *Monel has the combination of properties necessary to meet the requirements.*

★ At the Twin Branch plant of Indiana and Michigan Electric Company, subsidiary of the American Gas and Electric Service Corp., Monel tubing was installed in a pre-heater handling 550,000 pounds of water an hour at 3200 pounds pressure per square inch—under external temperature of 637° F.—feeding a boiler operating at 2500 pounds steam pressure!

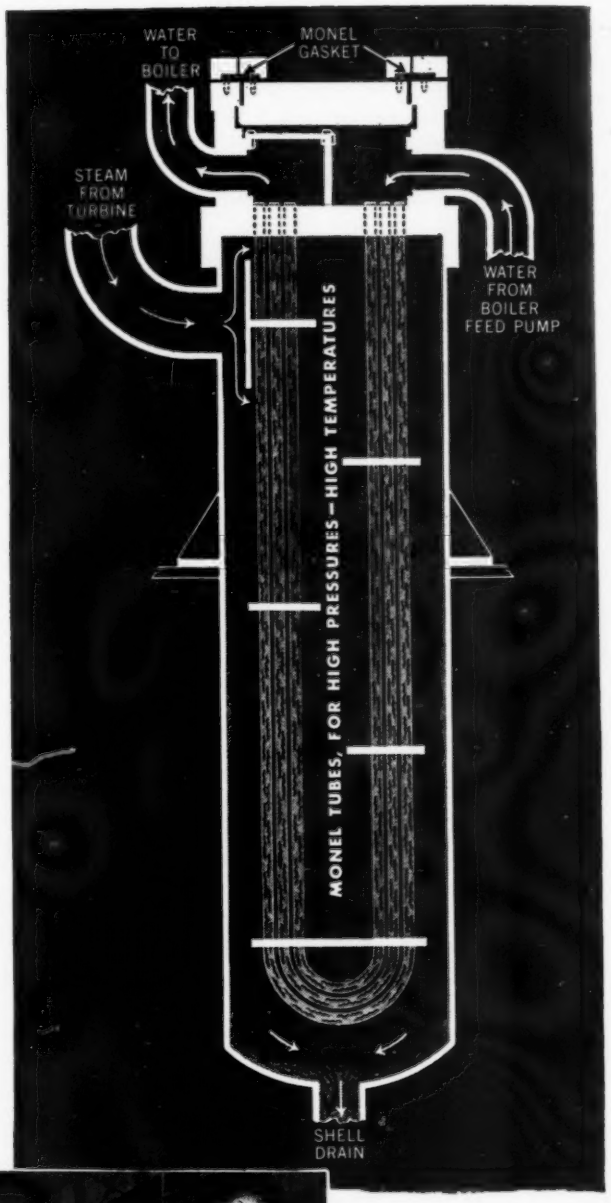
★ In Providence, R. I., the Narragansett Electric Company put one new high pressure boiler to work generating three times the power formerly obtained from eight low pressure units... using Monel tubing under external heat of 700° F., internal pressure of 1300 psi.

★ In the Oswego plant of the Central New York Power Corp., Monel heater tubing was installed to operate under 2000 pounds water pressure, at an outside temperature of 770° Fahrenheit.

Recently, these installations were examined after 3 to 4 years' service and their performance has confirmed the choice of Monel as a practical answer to the problem—the Monel tubing was still operating perfectly.

If you are considering the installation of high temperature-high pressure equipment, here is one problem that has already been solved for you. For a more complete discussion of the problems encountered and overcome in the Providence, Oswego and Twin Branch installations, write for a reprint of the article "27 TIMES THE POWER OUTPUT..." It includes the table of maximum allowable design stresses for non-ferrous materials taken from the proposed A.S.M.E. Boiler Code, and additional information about Monel heat exchanger tubing.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York 5, N. Y.**



EXPANDING TUBES *into the head of a pre-heater at Twin Branch. The excellent working properties of Monel are here in evidence. Monel tubing is ductile...can be expanded into snug-fitting durable connections with the head.*

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings

Yes, Men Make Motors!

NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

No machine can do that job — and no machine can fully test how well it is done.

There's only one test . . . wait 5, 10, 15 years and *see.*

And that's the test in which Allis-Chalmers motors have proved over the years that they're *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

• • •

YES, HUNDREDS of Allis-Chalmers men—craftsmen like Sam Meister — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a *friend* . . . and they know that's something no company and its workers can have too many of.

Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 1730

A-C WE WORK FOR VICTORY WE PLAN FOR PEACE

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

99 Years

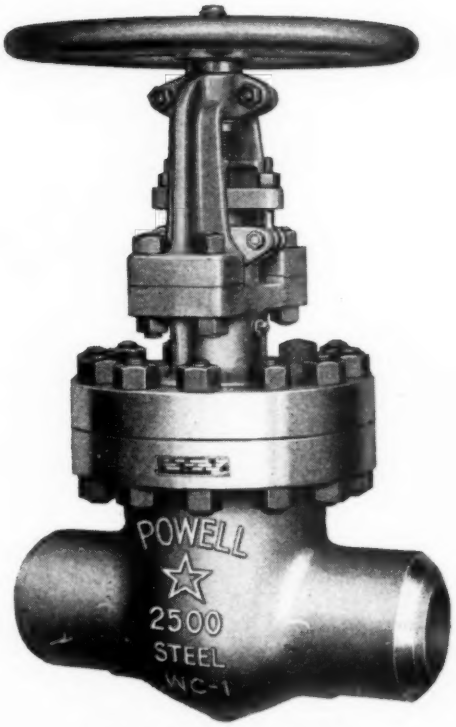
In a book on Cincinnati, published shortly after the Civil War, the following statement concerning The Wm. Powell Co. appears—"the Company, founded in 1846, manufactures the celebrated "Star" Regrinding Globe Valve, now in use in all parts of the country." Shown at the extreme right is the drawing used in 1865 to get the patent on this valve. The plant in which these valves were being made at that time is shown in the inset.

Today, in modern plant buildings covering many acres, the company is making a complete line of Globe, Angle, Gate, Check, Relief, Y, Non-return and other types of valves in bronze, iron, steel, pure metals and special alloys for corrosion resistance (catalogs on request).

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati 22, Ohio

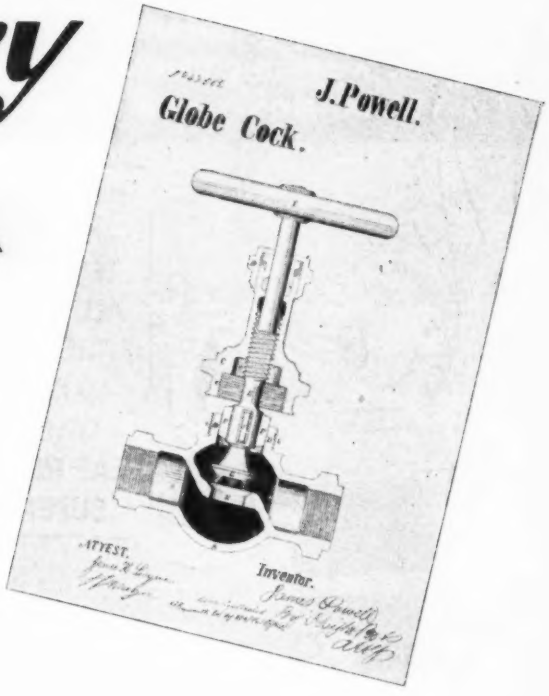


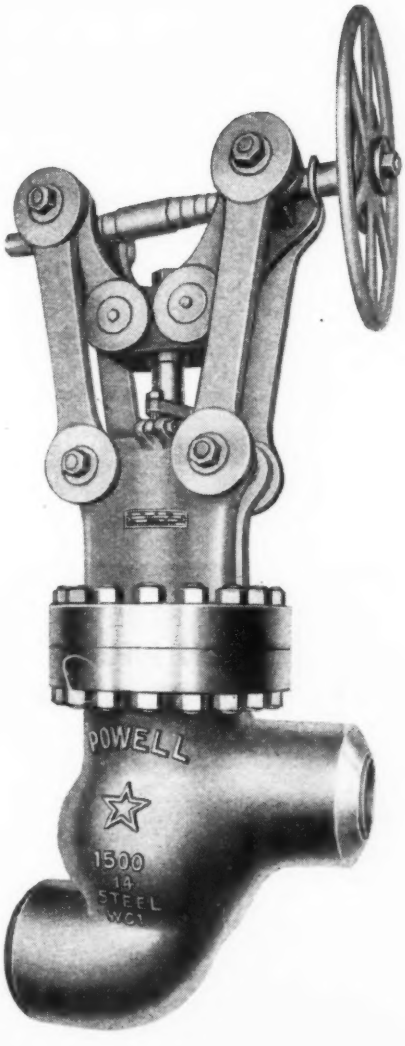
Class 2500-pound, Welding End, Cast Steel Gate Valve.

POWELL

of Leadership

in making valves for industry





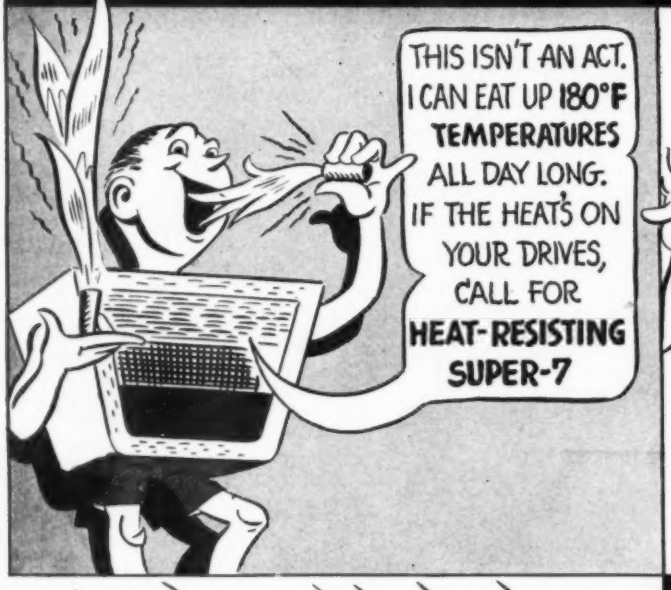
Through the years Powell Engineering has not only kept pace with, but has actually anticipated the flow control requirements of the vast power field. When the trend toward higher pressures and temperatures became evident, Powell was ready with the answer—a complete line of Cast Steel Valves—Globe, Angle, Gate, Y, Check, Non-return, etc., Hand, Gear and Motor operated—capable of handling every working pressure from 150 up to 2500 pounds and temperatures as high as 1400 F. Catalogs and detailed information will be gladly furnished on request.

The class 1500-pound, 14" welding end, toggle operated, Cast Steel Non-return Angle Valve shown here was designed to meet certain specific requirements. If *you* have any individual problems in flow control, Powell Engineering will gladly help you solve them.

VALVES

Greatest V-Belt Show ON EARTH!

EVERY MEMBER OF ALLIS-CHALMERS GREAT NEW V-BELT TEAM IS SPECIALLY DESIGNED, TESTED AND BUILT TO LICK A SPECIFIC DRIVE PROBLEM, SAVE YOU MONEY AND TROUBLE



DON'T WORRY IF YOUR BELTS MUST PRACTICALLY BATHE IN OIL OR GREASE. JUST ASK FOR SUPER-7 OIL-PROOF. I'M MADE OF IMPERVIOUS NEOPRENE.
OIL

IT PAYS TO MAKE **ALLIS-CHALMERS** YOUR

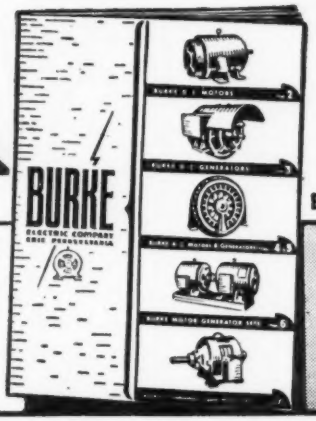
V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

What can BURKE do for Me?

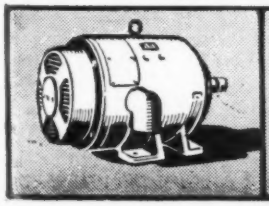
HERE'S a quick look at Burke Products to answer the headline question. When you examine each booklet, more specific questions will develop, questions that Burke engineers will be glad to answer.

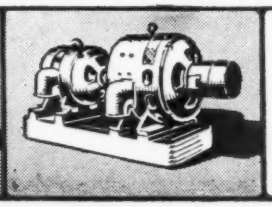
You may be surprised to learn that Burke pioneered and perfected the Universal Motor and the 3-Wire D. C. Generator, that Burke introduced the high cycle Motor Generator Set for powering High-speed Tools, and that Burke was first to use electric welding construction. In order to have you know Burke better we will be glad to send you a complete set of these Burke Bulletins.



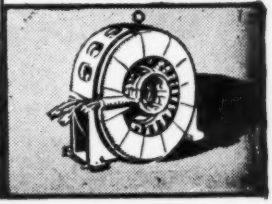
⇨ ⇨ For quick reference to the Burke line, see Sweet's Catalog File and Electrical Buyers' Reference Catalog.

BURKE ELECTRIC COMPANY • 1201 WEST 12TH STREET — ERIE, PENNSYLVANIA





D.C. Equipment to 1500 H.P. and 1000 K.W.
A.C. Equipment to 1500 H.P. and 1000 K.W.
M-G Sets to 1000 K.W.
Molded Bakelite Terminal Blocks



POWER FOR BIG STORES MUST BE SUPER-SAFE

Imagine power failure at dusk in a big store! Lights out...then panic, thievery...bad publicity. It is all too much to risk. That is one reason why large department stores favor ALCO Diesel Engines for safe, sure power, instantly available.

ALCO Diesel Engine designers pioneered in producing Diesel power units that have not only demonstrated extraordinary dependability, but provide required capacity with money-saving reductions in space and weight. On shore, in ships, and in mobile equipment, these characteristics are of vast importance.

These are solid reasons why more than 1,500,000 horsepower of ALCO Diesel Engines are in

service today. ALCO's powerful, reliable, compact, high-speed, ultra-durable engines are an immense advance over massive, cumbersome old-style engines.

That is why war demands call for all we can make. But ALCO research goes on. After the war, still better ALCO Diesel Engines will open your eyes to new possibilities in power availability, versatility, and efficiency.

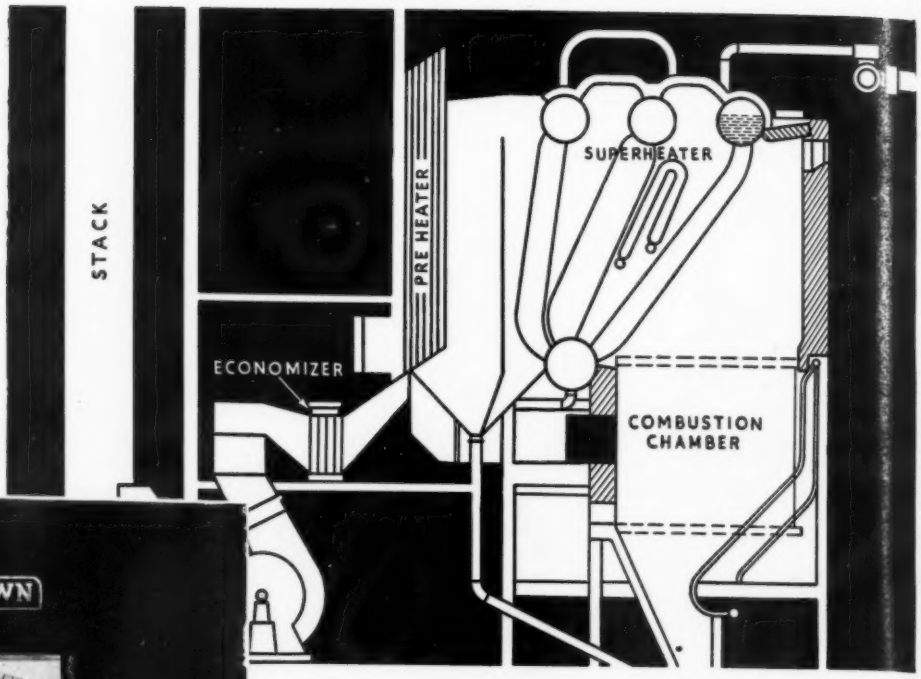
American Locomotive

ALCO DIESEL ENGINES

for Universal Application

30 Church Street, New York 8, N. Y.

ROBOT
156 x 63



CENTRALIZES TEMPERATURE READINGS

Eliminates Manual Balancing

Check these Temperatures within a few seconds —

Flue gas
Economizer
Preheater
Condenser
Bleed Steam
Feed Water
Hot Well
Steam
Air
Turbine
Superheater
Oil

The self-balancing Centralized Reading Indicator pictured above is as modern as jet propulsion.

The operator merely touches the desired switch. The instrument does the rest, leaving his hands free to log readings.

Time required between readings is limited ONLY by human ability to pick off a reading. Compare this time to that required to read an outmoded *manual* balance indicator, designed when shaving mugs were on every barber shop shelf.

The Brown Centralized Reading Indicator is unique for other reasons too.

The electronic "Continuous Balance" principle delivers sensitivity previously unheard of. Fancy being able to read one part in twenty-four hundred!

The *ElectroniK* is totally unaffected by vibration—mount it on a pulverizer frame if it suits your purpose.

The *ElectroniK* utilizes circular instead of reciprocating motion. Components move only when the scale is changing position.

Specify the Brown Precision Indicator for that post-war boiler.

Specify it, too, for your present station. Utilizing the same wiring and thermocouples, it readily replaces old-fashioned instrumentation.

Write for Bulletin 15-4, THE BROWN INSTRUMENT COMPANY, a division of *Minneapolis-Honeywell Regulator Company*, 4490 Wayne Avenue, Philadelphia 44, Pa. Branches in all principal cities. Canadian factory: 119 Peter Street, Toronto, Canada; Wadsworth Road, Perivale, Middlesex, England; Nybrokajen 7, Stockholm, Sweden.

BROWN *ElectroniK*
POTENTIOMETERS

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make SHAFTS Last Longer . . .

The Allis-Chalmers "Electrifugal" Pump is a unit-designed pump . . . with both impeller and motor mounted on one shaft and in one frame. The next time you need new pumps . . . look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps . . . the "Electrifugal" . . . and all types for every purpose.

WHERE YOU HAVE an Allis-Chalmers "Electrifugal" Pump . . . shaft and rotor pictured at left . . . you don't have an alignment problem—because *both* impeller and rotor are mounted on *one* shaft.

However, many pumps in use today are coupled to a separate motor, and how well the two are aligned has a lot to do with how long the shaft lasts . . . and the pump and coupling too . . . because misalignment starts all three fighting each other!

Here are a few tips which will help you get longer life out of pump shafts:

- See that pump and motor coupling flanges are parallel . . . both vertically and axially . . . and that they are kept that way!
- If misalignment recurs frequently, check foundations, piping, bolted connections.
- In the case of boiler feed or other pumps which reach high operating temperatures, be sure that alignment of motor and pump is checked after *both* have been operating. Otherwise they might develop misalignment from unequal expansion.
- If you haven't done so already, send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". Contains *no* advertising. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN. A 1707

Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.

MORE *POWER* PER POUND

ON LAND AND SEA

Throughout this war, as also in the first world war, the De Laval Steam Turbine Company has been building turbines and propulsion units in unprecedented quantities for merchant, navy and army ships—such as the new high speed, long range 20,000 ton, army troop transport illustrated above and equipped with De Laval Geared Turbines designed to furnish maximum power per pound of steam as well as maximum power per pound of equipment. . . . The improved designs developed by the De Laval Steam Turbine Company for meeting war time needs assure maximum economy in power and auxiliary units for post-war marine and land service.

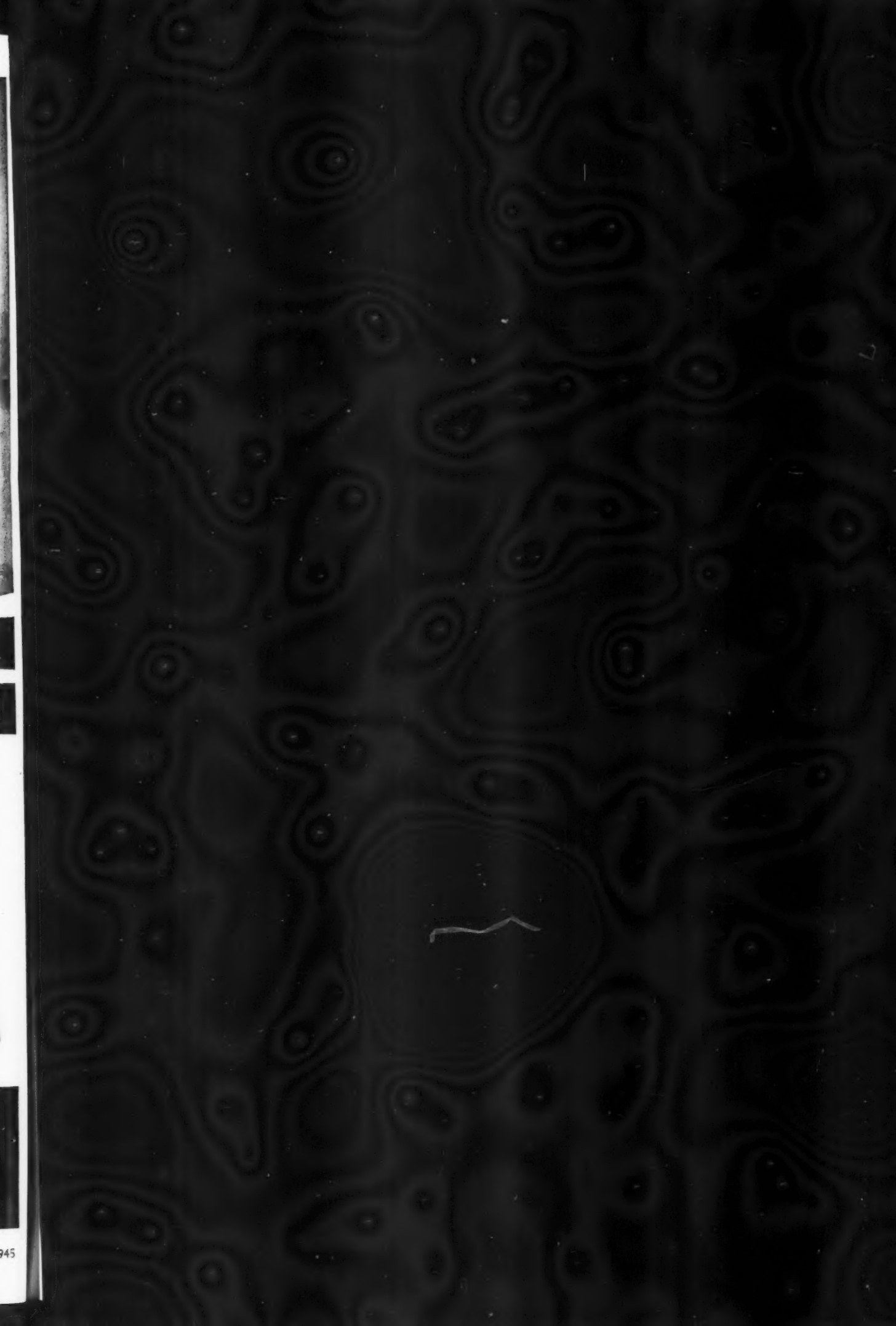
2150

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY - TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG



POWER

JANUARY, 1945 VOLUME 89, NUMBER 1

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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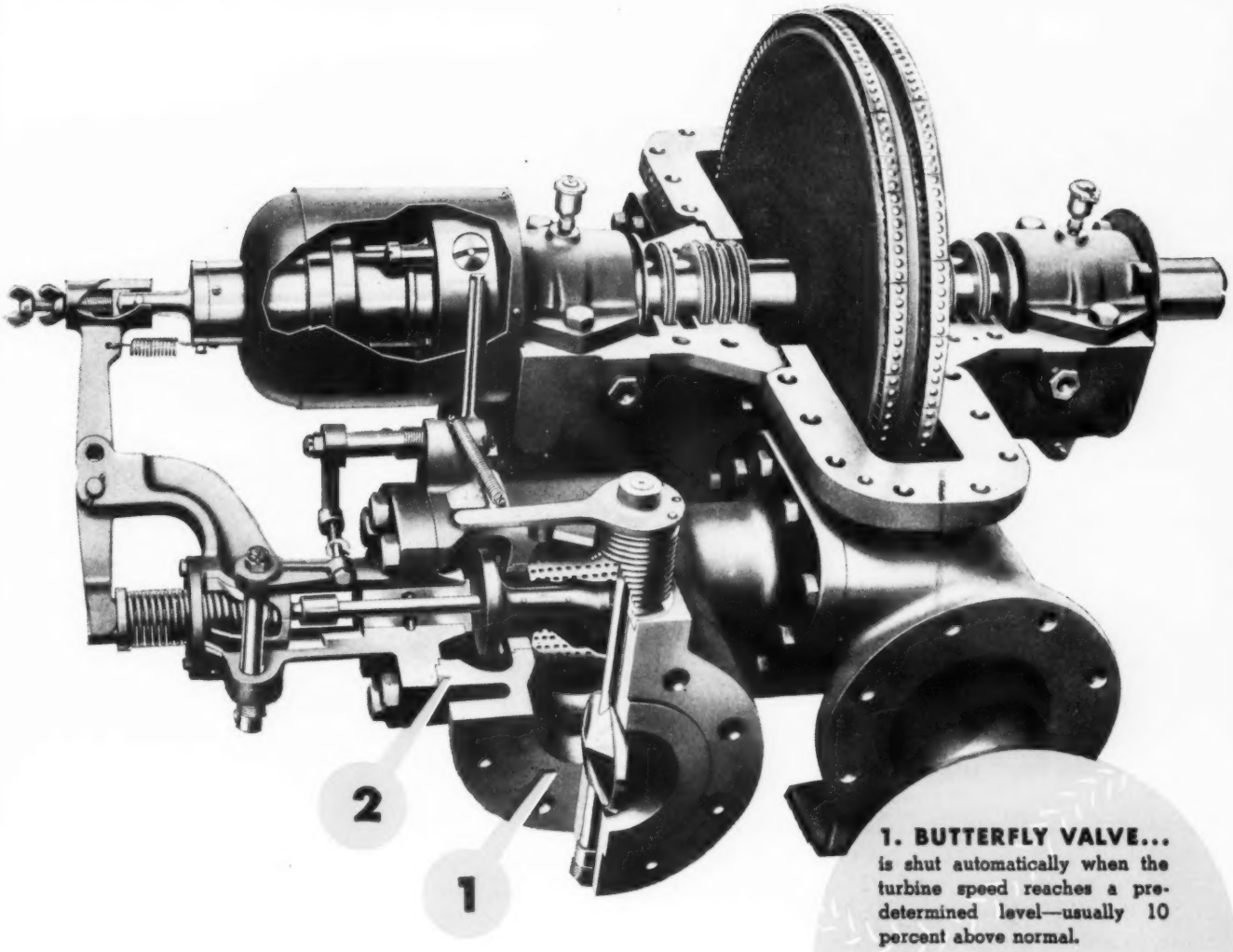

1. BUTTERFLY VALVE... is shut automatically when the turbine speed reaches a predetermined level—usually 10 percent above normal.

2. GOVERNOR VALVE... is tripped simultaneously with the butterfly valve—giving positive assurance that the steam supply will be shut off.

...STOPS OVERSPEED

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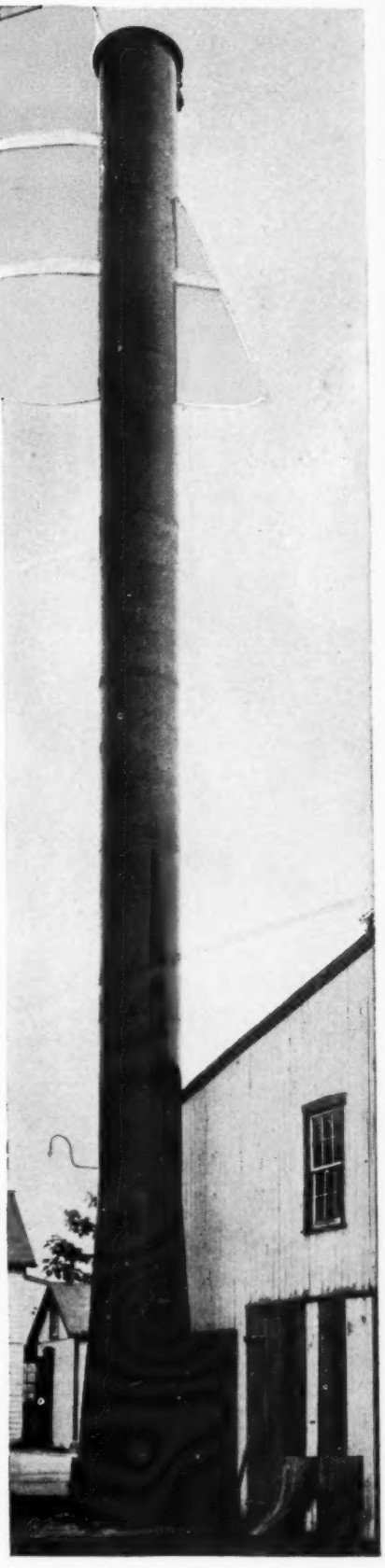
Steam Headquarters

WESTINGHOUSE

BYERS WROUGHT IRON

helps un-lined metal stacks

to retain their youth



Smoke is called an indicator of industrial production. It is frequently also an indicator of engineer headaches, for smoke means stack corrosion.

One solution that engineers in increasing numbers are adopting is shown in the picture. The stack—3-ft. in diameter and 60-ft. high—was fabricated from Byers Wrought Iron for a food processing plant by Lancaster Iron Works, Inc., Lancaster, Pa. The wrought iron plates are 3/8-in. at the bottom, and 5/16-in. at the top. The new stack replaces another, built of low-first-cost materials, which failed.

There is of course no known way of accurately anticipating the life of any particular unlined metal stack, because of the wide variation in initial conditions and the likelihood of future changes. But experience indicates very definitely that in applications where an unlined metal stack can be used, wrought iron generally lasts longer.

Some of the records that support this conclusion come from "composite" stacks, where of course there is unquestioned duplication of service conditions. In one instance, a 65-foot stack was constructed with its bottom 35-feet built of wrought iron, and the top 30-feet of low-first-cost material. During the next 28 years the top section failed 3 times; an average life of about 9 years. Wrought iron plates were then installed for the top section, and were still in use 20 years later. Furthermore, when the stack—no longer needed—was razed, it was found still in serviceable condition, and was sold and re-erected.

Flue gases contain carbon and sulfur compounds that—when absorbed by moisture—form aggressive acids. The ability of wrought iron to resist the attack of these acids is due to its unique structure. Tiny fibers of silicate slag, threaded through the high-purity iron matrix, give defense "in depth." Corrosive attack is halted and diverted, thus discouraging pitting. And the fibers help to anchor the initial protective film that shields the underlying metal.

You will find a helpful discussion of the general problem of corrosion, and pictures and performance records of wrought iron installations, in our bulletin, "Wrought Iron for Flue Gas Conductors and Coal Handling Equipment." Write for a complimentary copy.

A. M. Byers Co. Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

Corrosion costs you more than Wrought Iron

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TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • JANUARY 1945 • ESTABLISHED IN 1882

ACCORDING TO LIONEL D EDIE, economist and long-time observer of American industrial trends:

"Mechanization of plant and equipment is the only answer to the high hourly and weekly wage rates which will prevail after the war.

"The war will leave industry saddled with high labor cost, from which the only escape will be through mechanization.

"This trend toward mechanization will culminate in a great boom in the production of labor-saving machinery of all kinds. The whole phenomenon will extend over a period of three to five years."

Other well-informed observers say the same thing in other words. They agree that postwar America must and will achieve a higher production per man-hour than the world has ever known. They know that nothing else can insure a sound economy with good living for all. The essence of the argument is that economic and political factors will demand a combination of full employment, high wages and reasonable prices. The only way to get all three together is through labor-saving machinery.

As far as the individual manufacturer is concerned, the incentive to install labor-saving machinery will be the dire need of a profit margin rather than altruism. Just the same, the net result will be everybody's gain through a higher standard of living, widely diffused.

Now what does this mean for the power engineer? It takes no Einstein to see that labor-saving machines are worth nothing without the power to work them — horsepower and kilowatts — also steam, water, compressed air.

So Dr Edie's predictions lead straight to the further conclusion that power-service loads of all kinds — both centrally generated and generated within industry — will boom during the next five years. The power engineer's first job will be to supply these loads, dependably. Next he must supply them as cheaply as possible— through good operation and shrewd choice of power units, fuel, lubricants, and so on.

Finally, this same idea of labor saving (through instruments, controls, automatic fuel handling and firing, etc) will surely spread in the power plant as in the factory Here, as there, this will pay the higher wages and salaries without increasing the unit cost of the power services.

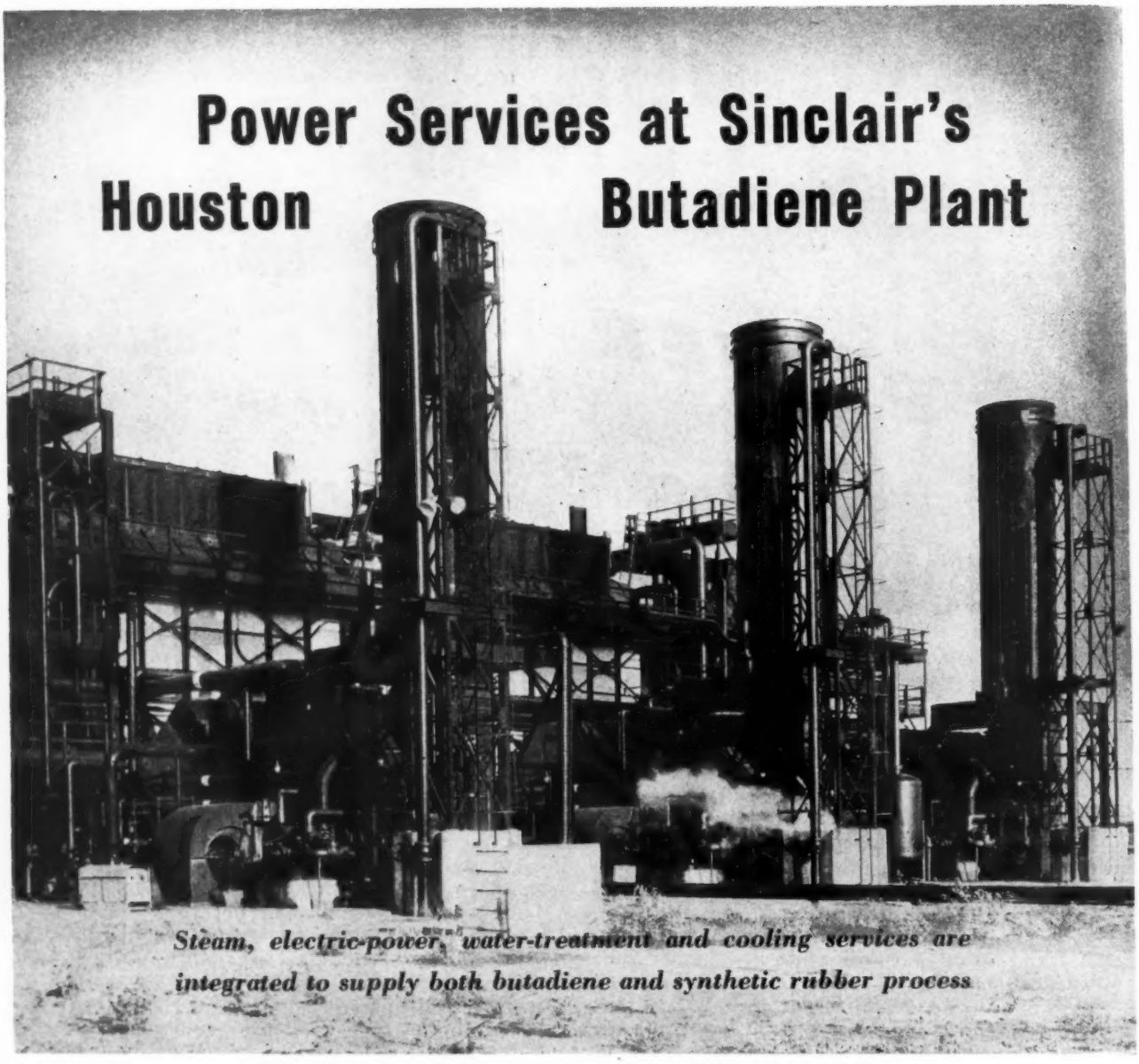
It won't do to close these comments without taking a quick crack at the widely held false notion that labor-saving machinery causes unemployment. It's one of those things that looks obvious and isn't so, just as the round world looks flat to the untrained eye.

Labor-saving machines do not reduce total labor. *They reduce the labor required to produce one unit of product.* That reduction shows up in dollar savings. These dollars are split five ways — to operator wages, to dividends, to salaries, to the men who make and maintain the machines, and to the buying public (in lower prices).

All five factors increase sales of this or other products or services, thereby restoring most of the man-hours of labor supposedly eliminated by the labor-saving machines. Another fraction of the gain from these machines appears, if the public so wills, as reduced working hours. Thus the typical work week shrank from 60 to 40 hours, while production boomed and living standards increased. This very leisure has made possible the enormous growth of gas stations, beauty shops and other service industries that account for so much employment today.

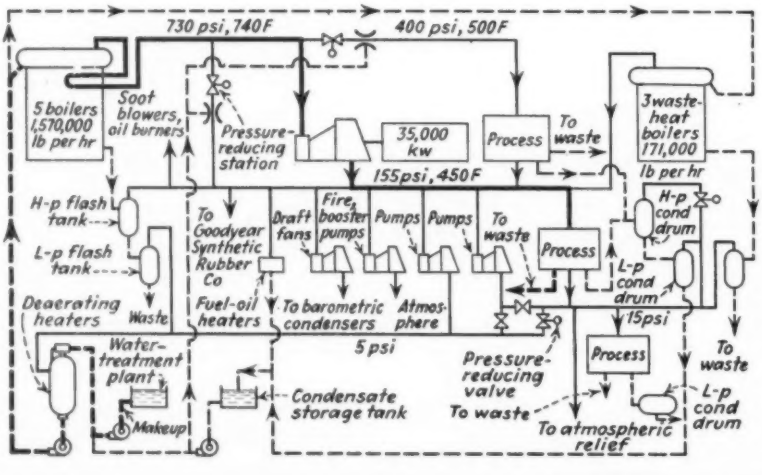
The difference between fumbling work and efficient labor-saving work is not one of unemployment versus employment but one of working long hours for a poor living versus working shorter hours for a good living. That is why the power engineer's job ties so closely into the future happiness of the American people. Such questions deserve better understanding by the men who make the wheels go round.

Power Services at Sinclair's Houston Butadiene Plant



Steam, electric-power, water-treatment and cooling services are integrated to supply both butadiene and synthetic rubber process

Five 300,000-lb-per-hr 800-psi 750-F outdoor boilers supply 35,000-kw back-pressure turbine and all process requirements. Fan-drive turbines exhaust to barometric jet condensers. Bulk of process steam passes through turbine but pressure-reducing stations can supplement flow at low loads



By LEWIS L RAYMER
Supt of Utilities
Houston Plant of Sinclair Rubber Inc

▶ WITH INAUGURATION in 1941 of the government-financed synthetic-rubber program, Sinclair Rubber Inc (a 100% subsidiary of Sinclair Refining Co) was charged with responsibility for design, construction and operation of a 50,000-ton-per-yr butadiene plant with its associated steam, power and water utilities. This installation, operated by Sinclair Rubber Inc for Rubber Reserve Co, represents 7% of the total designed capacity for butadiene production. An adequate supply of feed stock butylene and an abundance of natural gas for fuel favored a location just outside the city limits of Houston, Texas, for the

butadiene plant proper and an associated copolymerization unit operated by Goodyear Synthetic Rubber Co for manufacture of Buna S type rubber.

Because of the large size of this combined project and the fact that all services for both plants are supplied by facilities of the butadiene plant, reliability and continuity of operation are of paramount importance. In view of the fact that the area in which the plants are located is subject to frequent electrical storms of severe intensity as well as other tropical atmospheric disturbances, use of electrical equipment in the power station has been minimized in favor of steam drives at all critical locations even at some sacrifice in overall thermal economy.

Principal features of the plant utility system are (1) steam-generating units (2) water-treatment system (3) turbine-generator arrangement and (4) cooling-water system. In each of these are elements of interest to other engineers either because of unusual size or characteristics of design.

Boiler Plant

The steam-generating plant consists of five 300,000-lb-per-hr boilers designed for 800-psi drum pressure and 750-F steam temperature, each equipped with a regenerative air preheater. Forced- and induced-draft fan turbines exhaust to jet-type barometric condensers. Each boiler has six combination burners normally fired with part natural gas and part waste gas from the butadiene plant. For emergency only, a complete fuel-oil system, including steam heaters, has been included.

Since steam demand for process is practically constant, automatic control is provided only for feedwater flow, with drum-level reset. Remote push-button control regulates forced- and induced-draft fans and dampers from each boiler operating panel. Five turbine-driven centrifugal pumps, operating in parallel through oil-relay governors, supply deaerated feedwater at 900 psi and 225 F to all boilers through a common header. Typical operating results from these units and usual fuel-gas analyses are shown in Table I.

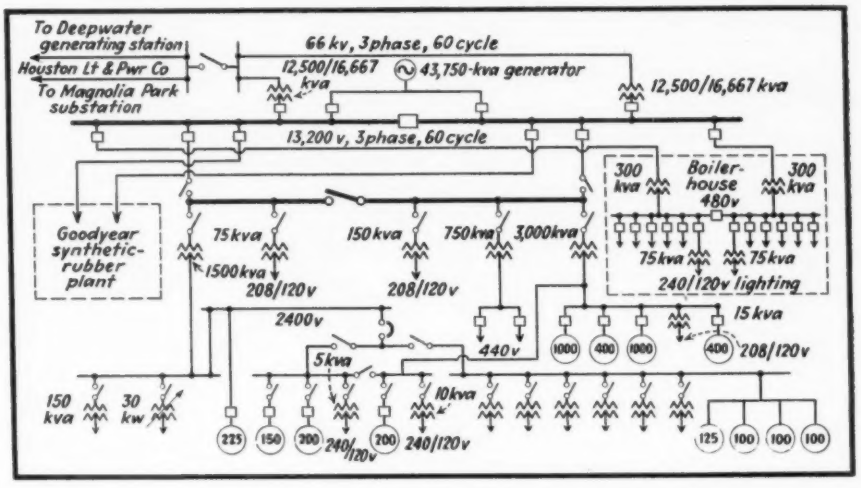
Concentration of salines in boiler water is maintained at 1500 ppm by a continuous blowdown system flashed at 150 and 5 psi. Free phosphate to the extent of 40 to 60 ppm (expressed as PO_4) is maintained in the boiler water. Solids in the saturated steam entering the superheater have averaged less than one ppm while carbon dioxide content has varied from 5 to 15 ppm.

Design of the water-treating plant is predicated on the use of water either from the San Jacinto River through a system of canals and pressure mains or from deep wells at the plant site. For either supply, current high-pressure boiler practice dictates that silica be removed and that total dissolved solids in the boiler feedwater be reduced to an economic minimum. Selected for this was the cold-lime process, using dolomitic lime and ferric sulphate as a coagulant, in conjunction with sodium and hydrogen Zeo-carb softeners.

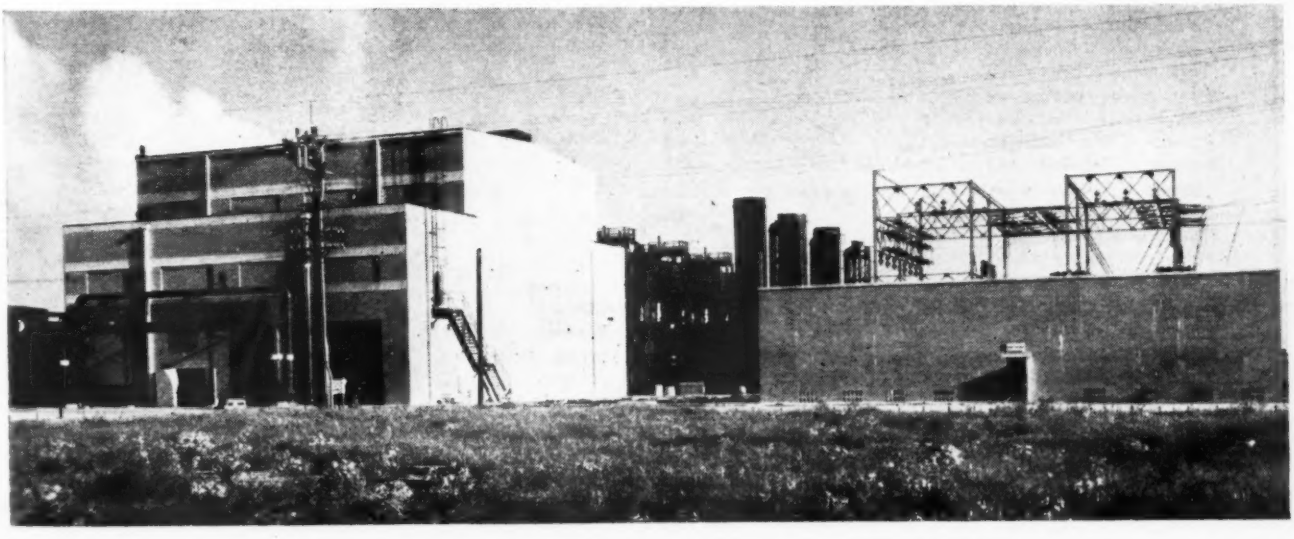
Water Treatment

Under design conditions about 4800 gpm of raw water enters the treating plant through a rate-of-flow controller equipped with meter and electrical contactor, then flows directly into the magnesium dissolver into which sludge from the precipitators is recirculated. Slaked dolomitic lime and ferric sulphate are automatically proportioned to the water flow in predetermined dosage.

Ferric sulphate is injected into the raw-water and recirculated-sludge



Electrical generation at 13,200 v is distributed to unit substations with excess power stepped up to 66 kv for interconnection with utility system. Latter supplies 7000 kva of standby in event of main turbine outage. Generator and main-feeder breakers are air-blast type using 250-psi air for operation and extinguishing arc



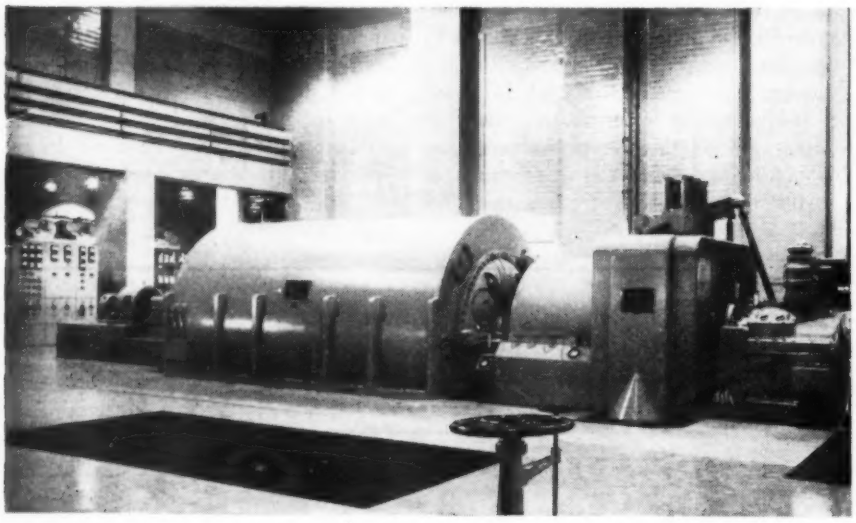
stream at the outlet of the magnesium dissolver. Lime is then added and the mixture flows to two Spaulding precipitators in parallel rated at 2400 gpm each. Sludge is removed by precipitation, being withdrawn continuously from the precipitators for recirculation to the magnesium dissolver and for waste to a sludge-disposal pit. Carbon dioxide is added in the magnesium dissolver through a perforated grid to convert hydroxides into carbonates and bicarbonates to yield ionic magnesium in solution for silica absorption.

Precipitator effluent passes through six Anthrafilt gravity filters and is then recarbonated with carbon dioxide for further conversion of hydroxides and carbonates to bicarbonates. Carbonation also reduces pH ahead of the Zeocarb softeners.

Nine wood-tank gravity softeners are arranged in batteries of three units each. Of these one battery is equipped for regeneration with sulphuric acid, one with commercial sodium chloride and the third with either, as may be required. When processing river water of comparatively low carbonate alkalinity, two batteries operate on the sodium cycle and one on hydrogen. For high-bicarbonate well water, two batteries are required on the hydrogen cycle and only one on sodium.

Softener operation is entirely automatic in so far as regeneration is concerned. Desired alkalinity of softened water is controlled by the relative amount of water through each battery. Blended effluent from the softeners passes to a degasifier for removal of CO_2 formed in the hydrogen softeners.

From the soft-water well, pumps deliver the flow directly to two 875,000-lb-per-hr spray-type deaerating heaters in which temperature is brought to 225 F to effect removal of free carbon dioxide and oxygen. Sodium sulphite is fed into the storage sections of these heaters to absorb any slight residual oxygen. Finally, sodium hexametaphosphate is added to the deaerated water in the suction line of the boiler-feed pumps.



Turbine can pass as much as 1,200,000 lb per hr of steam to 150-psi process lines when operating at full 41,000-kw load. The 3600-rpm generator is hydrogen cooled

Operating Results

The water-treating plant is designed for a net output of 4000 gpm; about 800 gpm are consumed in various stages of treatment. Test values in Table II indicate condition of water at various points.

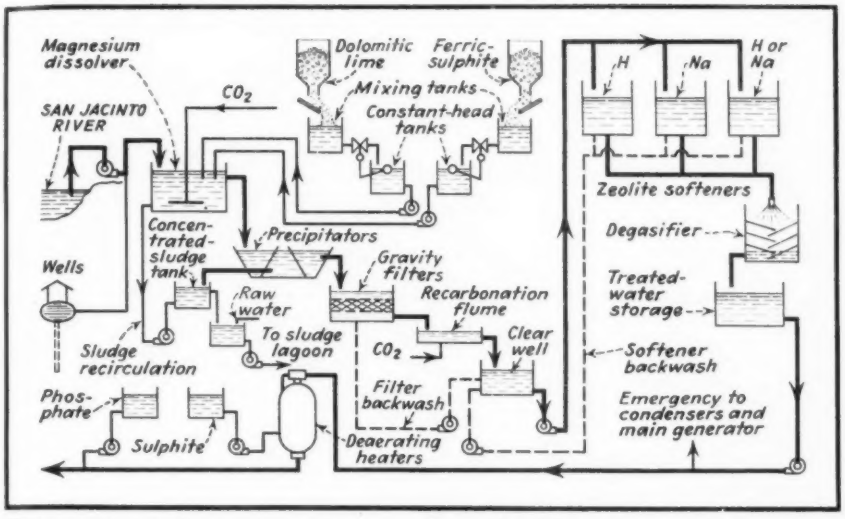
Chemicals are purchased in bulk, unloaded mechanically and supplied by gravity to various chemical-feed units.

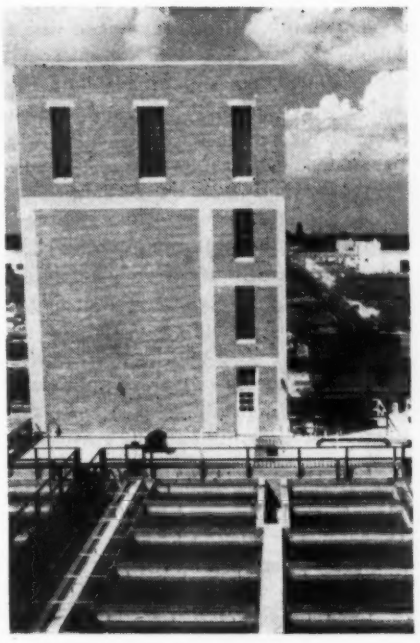
Table I—Fuel and Performance Data for Main Boiler Units

Boiler Data	
Evaporation, actual, lb per hr	295,000
Temperature feedwater entering boiler, F	226
Temperature of steam leaving superheater, F	745
Temperature of air entering air preheater, F	90
Temperature of air leaving air preheater, F	558
Temperature of flue gas leaving boiler, F	698
Temperature of flue gas leaving air preheater, F	350
Drum pressure, psi	757
Steam pressure leaving superheater, psi	735
Furnace pressure, in. water gage	−.3
Pressure at boiler outlet, in. water gage	−4.8
Pressure at preheater outlet, in. water gage	−7.7
Pressure in windbox, in. water gage	9.4
Percent CO_2 leaving boiler	9.55
Percent O_2 leaving boiler	4.05
Percent CO leaving boiler	0
Percent N_2 leaving boiler	86.4
Percent excess air leaving boiler	21.5
Percent CO_2 leaving air preheater	9.0
Percent O_2 leaving air preheater	5.0
Percent CO leaving air preheater	0
Percent N_2 leaving air preheater	86.0
Percent excess air leaving air preheater	28.0
Fuel consumption, thousands of cu ft per hr	413.4
Heat value of fuel consumed, million Btu per hr	422.5

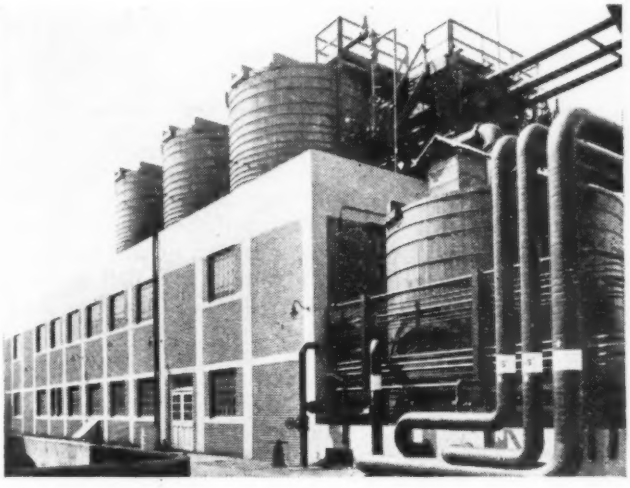
Heat Balance	*Million Btu per hr*	*Percent*
Heat absorbed in boiler	296.7	70.22
Heat absorbed in superheater	49.9	11.81
Total heat absorbed	346.6	82.03
Loss due to burning hydrogen	46.1	10.91
Loss in dry flue gas	22.8	5.40
Radiation and unaccounted for	7.0	1.66

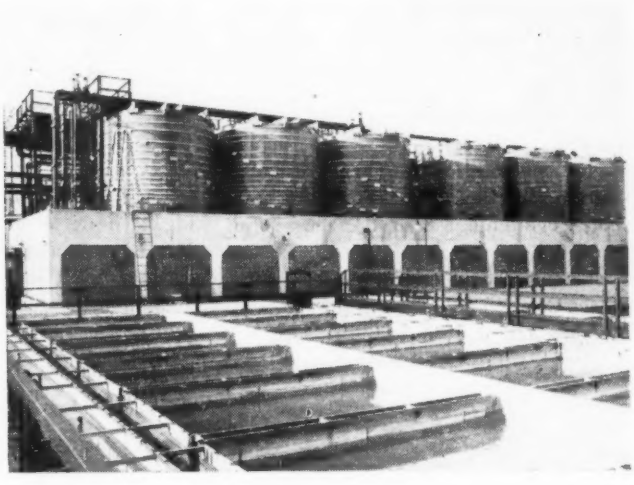
Fuel-Gas Analysis	*Natural Gas*	*Process Gas*
Carbon dioxide	0.30	11.97
Carbon monoxide	——	0.27
Hydrogen	——	65.85
Methane	96.30	12.89
Ethane	2.40	1.95
Propane	0.54	4.77
Butane	0.25	1.55
Pentane	0.12	0.75
Nitrogen	0.09	——
Specific gravity	0.58	0.45
Btu per cu ft gross at 14.7 psi, 60 F	1040	562





Water-treatment plant can use river or well supply, delivers zero hardness, removes nearly all silica. *Above:* schematic flow arrangement showing steps in chemical treatment and pumping. *Right:* chemical storage building, magnesium dissolver and precipitators. *Below, left:* filter building showing softener tanks and degasifier. *Below, right:* view of softeners from another angle with precipitators in foreground





Data compiled during the relatively short period this unit has been in operation indicate the following chemical consumption:

Chemical	*Lb per 1000 gal*	*Ppm*
Dolomitic lime	1.94	232
Ferric sulphate	0.28	34
Sodium chloride	2.25	270
Sulphuric acid, 66 Bé	0.84	101

With respect to power generation, studies conducted by the power division of War Production Board during early stages of plant design indicated a potential power shortage in the Houston area due to a large influx of war industry. Since process use aggregates 1,300,000 lb per hr of 150-psi steam, installation of a 35,000-kw 3600-rpm hydrogen-cooled turbine-generator exhausting at 165 psi was authorized. Electrical requirements of both butadiene and Buna S plants total less than the available generating capacity so that surplus electrical energy is available; since no standby unit is installed, an agreement with Houston Lighting & Power Co provides for disposal of surplus energy and furnishing of standby service to the extent of 7000 kva.

Process Steam

From the main header, steam at 725 psi and 740 F goes to the turbine through two 14-in. lines with stop valves and thence through four 10-in. lines into the upper and lower steam chests. The turbine unit has a limiting capacity of 41,000 kw under present system power factor, passing 1,200,000 lb per hr of steam at that load. Exhaust steam at 150 psi discharges through two 20-in. lines into the main 24-in. headers and blends with steam from the pressure-reducing station.

Electrical energy generated at 13,200 v is distributed to unit substations at generator voltage while the excess is stepped up to 66 kv for delivery to the utility company's main transmission system. Generator and main feeder circuit breakers are air-blast type using compressed air at 250 psi for operation as well as extinguishing the arc.

Two parallel pressure-reducing and desuperheating stations, rated 200,000 lb per hr each, supply 400-psi 500-F steam to the butadiene plant. Two other 700,000-lb-per-hr stations in the turbine-room basement provide steam at 150 psi and 450 F for process use when the turbine is out of service or operating at reduced load and producing less exhaust steam than process needs.

For producing butadiene of high purity, extensive fractionation is required. Large quantities of water are needed to cool and condense the hydrocarbon vapors, amounting normally to 120,000 gpm. An induced-draft cooling tower, 135 ft wide and 580 ft long, is

divided into 32 cells arranged in a double row.

Six 20,000-gpm pumps circulate the cooled water through the process-plant area. Four pumps are driven by 900-hp condensing turbines through reducing gears and two by 1000-hp synchronous motors. One turbine- and one motor-driven hotwell pump, of 20,000 gpm each, return water from condensers at the cooling tower and power plant to the top of the tower. Makeup in the amount of 4000 gpm comes directly to the tower coldwell from the main San Jacinto water line servicing the plant. A 22-million-gal raw-water storage reservoir supplies either the cooling tower or the power plant in emergency.

Desuperheating Supply

About 50% of the total steam produced returns to the boiler plant as 212-F condensate. From this is taken water for desuperheating process supply and gland sealing water for the main turbine. With the main turbine out of service, more than 300 gpm of condensate is needed for desuperheating alone. Storage facilities for 700,000 gal of condensate have been provided in the event the condensate supply becomes contaminated or the flow is interrupted.

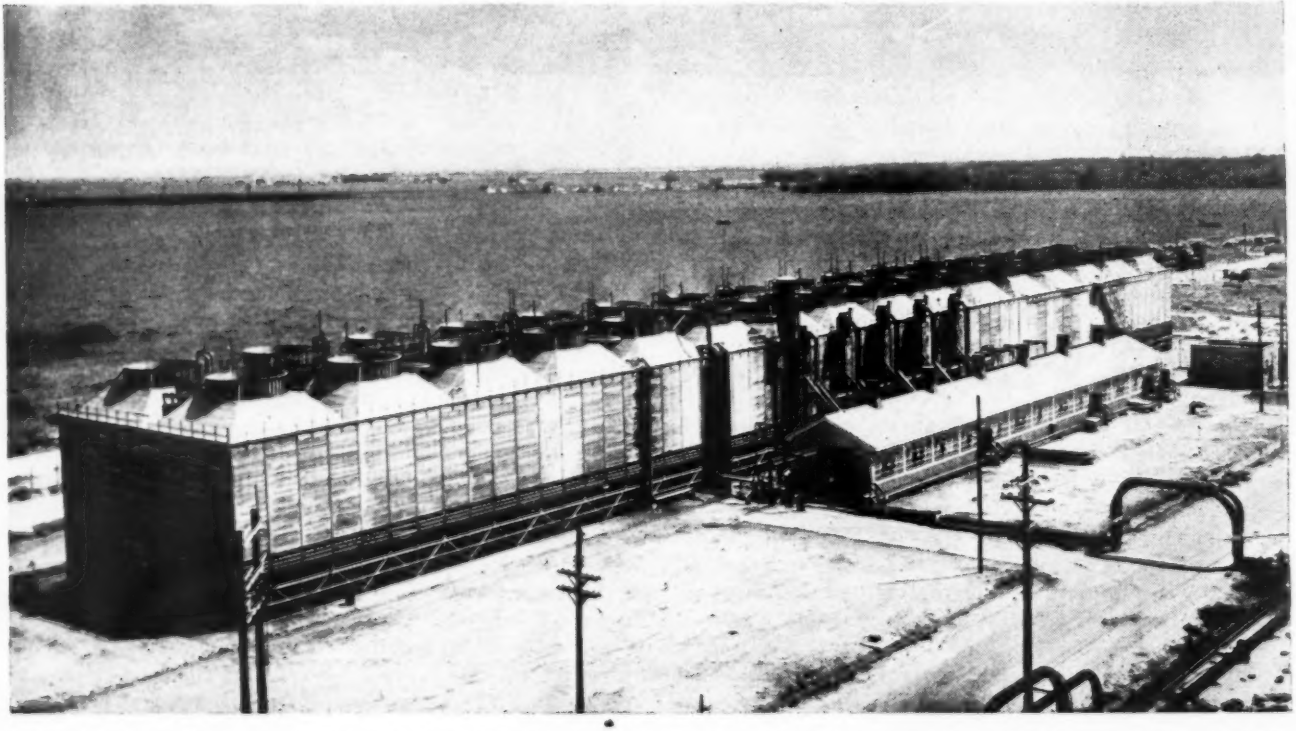
Steam supply to the butadiene plant passes through a 20-in. and a 24-in. 150-psi line and a 16-in. 400-psi line. A 20-in. line returns 15-psi exhaust steam to the power plant for feedwater heating. The adjacent Buna S plant takes 150-psi steam through a 14-in. line. Fully treated water at 200 psi in the amount of 400 gpm is supplied waste-heat boilers in the butadiene plant.

Table II—Typical Water Analyses

	Raw river water, design	Raw river water, actual	Magnesium dissolver	Precipitator effluent	Filter effluent after carbonation	Softener effluent, sodium	Softener effluent, hydrogen	Degasifier effluent	Deaerated boiler feedwater
Total hardness as $CaCO_3$	75	52	235	70	70	0	0	0	0
Hydrates as OH	0	0	0	25	0	0	0	0	0
Carbonates as $CaCO_3$	0	0	36	40	0	0	0	0	12
Bicarbonates as $CaCO_3$	60	55	164	0	62	67	0	33	14
Chlorides as Cl	60	16	16	16	16	16	16	16	14
Sulphates as SO_4	3	9	9	30	30	30	30	30	26
Sulphites as SO_3	—	—	—	—	—	—	—	—	3
Phosphates as PO_4	—	—	—	—	—	—	—	—	3
Phenol alkalinity as $CaCO_3$	0	0	18	45	0	0	0	0	6
Methyl orange alkalinity as $CaCO_3$	60	55	200	65	62	67	—	33	26
Free mineral acdity as $CaCO_3$	—	—	—	—	—	—	40	—	—
Free carbon dioxide as CO_2	5	—	—	—	—	—	—	3	0
Oxygen as O_2	—	—	—	—	—	—	—	—	0
pH	7.2	7.4	9.9	10.6	7.5	..	..	7.2	8.8
Silica as SiO_2	19	16	12	3	2	—	—	2	2
Turbidity	—	50	—	3	0	—	—	—	—
Total dissolved solids	183	108	—	—	—	—	—	106	100

* *Tests shown are for filtered sample. All analyses, with the exception of pH values, are expressed in ppm.*

Design of power plant and auxiliaries was under supervision of the author, power plant superintendent for Sinclair Rubber Inc. Design details were handled by J Gordon Turnbull Inc and plant construction was by George A Fuller Co.



Induced-draft cooling tower 135 ft wide and 580 ft long is divided into 32 cells arranged in a double row, handles 120,000 gpm. Ten cells have motor-driven fans; the remaining 22 are equipped with turbine drives exhausting to a single condenser

How to Maintain Diesel Pistons and Rings

Condition of pistons and rings has a direct, important effect on engine performance, yet they seldom receive the care that is their due. G H Menefee, USNR, tells how to keep diesels healthy by making sure pistons and rings are in good shape

Fig. 1—Contamination of lubricating oil caused stuck rings on piston at left. Stuck rings reduce combustion efficiency and allow unburned fuel to reach the crankcase, further contaminating lube oil. Photo at right shows final result of ring sticking. Lube-oil failure caused crankpin bearing to burn out. Bearing seized, connecting-rod foot broke off and rod and piston went through crankcase

▶THE AVERAGE OPERATOR seldom gives a piston and its rings the care they are entitled to. He assumes they are more or less ruggedly built, that clearances are not as exact as in other parts, and that maintenance is, therefore, relatively less important. But when they are not given proper attention they are a prolific and even a major source of trouble and poor engine performance.

Unless there is earlier evidence of trouble, pistons should be removed for inspection about every six months, and completely overhauled about once a year. They may not have to be removed so often for large, slow-speed engines.

Removing piston. Remove cylinder head and disconnect connecting rod from crankpin. Clean eyebolt holes in piston top and insert eyebolts. Wrap cylinder-head studs with rags to prevent their threads damaging piston rings or skirt. If a shoulder has worn at top of liner, remove it to prevent damage to ring lands. Stuff a rag into cylinder to catch chips, and remove shoulder with a machinist's scraper. Or, preferably, use a ridge reamer, and set its blade so it cannot cut more than $\frac{1}{32}$ in. below the ridge.

Remove chips and pull piston, being careful to keep connecting-rod foot from scoring cylinder. If all pistons are pulled at one time, wrap rags around their rings as they are removed to protect them from damage. Be sure to mark pistons so that they will be returned to proper cylinder. After removal, examine them for scores, wear in ring grooves, ring clearance in grooves, cracks, piston-pin clearance in pin bosses, and roundness.

Cleaning piston for inspection. Remove and tag rings so they may be replaced in the same grooves. If rings stick, soak piston in kerosene. If this does not loosen them, soak in a solution of 25% muriatic acid a short while. If acid is not available, use a solution of 1 lb lye to 3 gal boiling water. After using either solution, wash piston thoroughly in clean water to prevent corrosion. There are also several good cleaning solutions on the market.

Use Proper Cleaner

Because of scarcity of some materials, engine builders are using alloys containing magnesium. This is especially true of bronze bushings and aluminum-alloy pistons. Under no conditions use lye as a cleansing agent with this equipment as it causes failure of any aluminum part or any part containing magnesium. In such instances a solution of trisodium phosphate may be safely used.

Piston top may be scraped or brushed free of carbon with a wire brush. However, never use one on ring belt or skirt for it is almost certain to scratch ring grooves and prevent proper seating of rings. Using the brush on the skirt would remove any coating, such as tin-plating, which the manufacturer may have added for better wearing qualities. Scrape ring grooves clean with end of a broken ring that fits the groove, and use it carefully.

Some manufacturers now coat engine pistons with *anti-seize* compound. This coating is baked into the metal, giving it a dark, grayish cast and permitting closer clearances between piston and cylinder wall. After some hours of operation the coating has the appearance

of a carbon deposit. The coating is necessary to engine operation, so do not remove it by buffing or scraping. If the cleaning agent does not remove the discoloration, it is safe to leave it on the piston.

Measuring clearance. Pistons are usually tapered from top of crown to bottom of ring belt, to allow for greater expansion of the heavier top part. To measure clearance, piston is inserted into cylinder, and clearance between piston and cylinder measured with feeler gages just below the ring belt. Clearances for pistons under 10 in. diameter should be about .0015 in. per in. of cylinder diameter for aluminum pistons, and .001 in. per in. of cylinder diameter for cast-iron pistons. For cylinders above 10 in. diameter, clearance is about ¼ of a thousandth in. less, per in. diameter.

Repairing fractures. Pistons suffer from two general fractures: (1) radial fractures in piston crown and (2) circumferential fractures in the crown, just below it, or through the piston-pin bosses. These two fractures are almost always caused by excessive heat due to overload or failure of cooling system. Caught in time, fractures may usually be repaired. Small pistons are usually replaced if spares are available, but replacement of large ones involves considerable expense.

Lacing, Fig. 2A, is the usual method of repairing radial cracks: Cut a groove over the crack about ⅜ in. wide and ¼ in. deep for full length of crack. Next, holes that touch each other are drilled and tapped to ¼ in. diameter. Drill deep enough to give sufficient purchase, but not completely through piston head. Brass rod of the proper size is threaded and, after being dipped in a metallic cement, is screwed into the holes. Rod is then cut off about ¼ in. above piston top and carefully peened into the groove with a light hammer. Grind away any brass that remains above piston surface so there is no possibility of any projection hitting any part of cylinder head.

Other Types of Repairs

Another method of repairing a radial crack is to recess the head to receive a fitted plate of sheet steel, which is coated on the under side with metallic cement and bolted to piston crown with flat-headed screws, Fig. 2*B*. Under no condition allow screws to project above piston surface.

For circumferential fractures, make repairs by boring out piston crown to receive a plug, attached as shown in Fig. 2*C*. Be sure it seats well for a great amount of heat must pass through this joint while engine is operating. Also be sure to coat the joint with a metallic cement. However, if a circumferential crack is below the piston crown, it may not be repaired unless piston is made in sections. In such a case, install a new segment in place of the broken part.

Seizing. This is one of the worst accidents that can happen to a piston. It is caused by a piston becoming so hot on one area of the skirt that it welds itself to a similarly heated portion of the liner. A high spot on the piston breaks down the oil film on the cylinder wall, and the extreme heat generated forces piston against opposite cylinder wall where the same thing occurs, causing the piston to seize. Seizure almost always scores the piston so badly that it is impossible to repair it with any success.

First indication of seizure is a heavy laboring in the engine, pounding in the cylinder, slowing down of engine, and heavy smoking in the exhaust. Stop the engine immediately and pull the piston for examination. If engine is not stopped at once there is imminent danger of a crankcase explosion or a broken crankshaft. When it is impossible to stop an engine, as may be true with a marine engine, stop fuel flow to the cylinder in distress, open the test cock to relieve compression, and increase lubricating-oil flow to the cylinder. Once started, seizure progresses rapidly.

Piston out-of-round. Should a piston be out-of-round, place it on a block of wood with large diameter vertical. Careful but repeated pounding on the high side with a wooden or rawhide mallet brings it back into shape.

Wristpins and wristpin bearings. They may be a source of much trouble if an operator does not understand their installation and care. A wristpin bearing is one of the most highly loaded in the engine, and one of the smallest. Therefore give it careful attention.

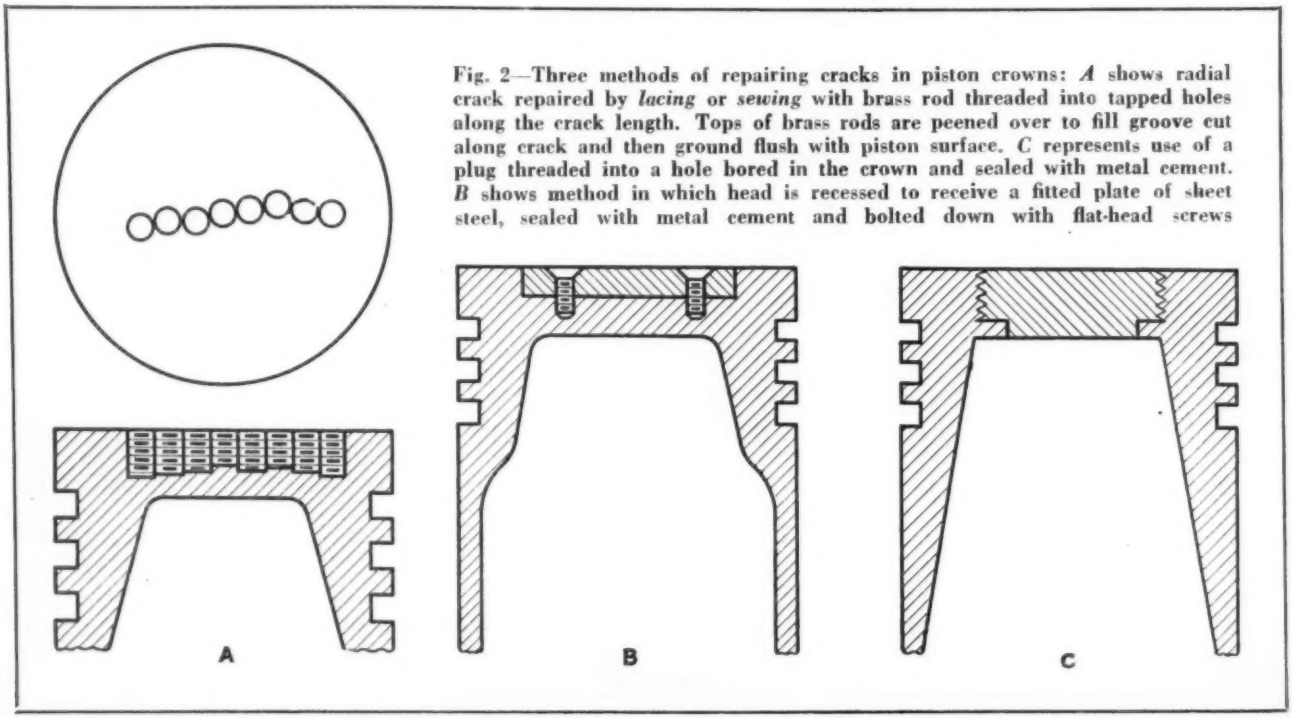


Fig. 2—Three methods of repairing cracks in piston crowns: *A* shows radial crack repaired by *lacing* or *sewing* with brass rod threaded into tapped holes along the crack length. Tops of brass rods are peened over to fill groove cut along crack and then ground flush with piston surface. *C* represents use of a plug threaded into a hole bored in the crown and sealed with metal cement. *B* shows method in which head is recessed to receive a fitted plate of sheet steel, sealed with metal cement and bolted down with flat-head screws

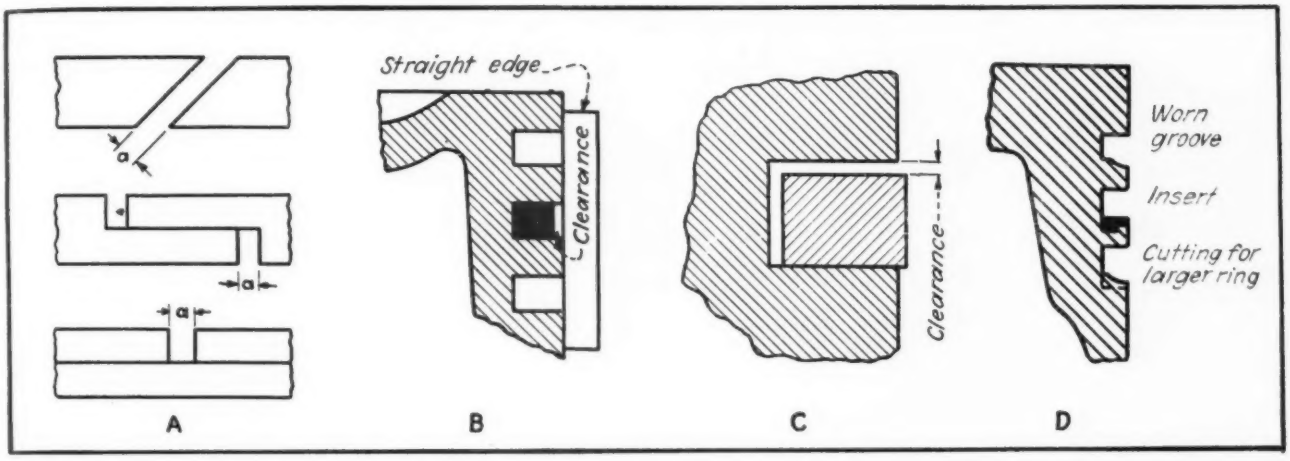


Fig. 3—Diagrams *A*, *B* and *C* show end, depth and side clearance, respectively. *D* shows methods of repairing worn grooves

If the pin bearing is the roller type, check rollers and races for chipping and scoring. When any part of the roller bearing is damaged, it is best to replace the entire bearing. To check wristpin alignment, bolt connecting rod to crankpin and measure distance between piston bottom and crankpin on each side of the connecting rod. Pin is in alignment only when the two measurements are equal. Measure with an inside micrometer or a tram. Examine the oil passages in the connecting rod to make sure wristpin bearing will receive enough lubricating oil. Also check piston cooling tubes to see that they are open, and joints free from leakage.

Several diesel engines depend on scrapers on the piston-pin end to lubricate the bearing. These scrapers are held against the cylinder wall by a light spring, which is contained within the piston-pin boss. Check frequently the spring's condition and clean gum and carbon from the oil passage.

Check Wristpin Clearance

Whenever piston is pulled for inspection, check wristpin for clearance in the bushing and for roundness. Wristpin is generally given a clearance of .001 in. per in. diameter in its bearing. It should be changed when out-of-round is greater than .003 in.

A seized wristpin usually results from a hot wristpin bushing. It will damage pin or piston if engine is not stopped immediately. There is also a chance that rod may be bent or broken.

A hot wristpin in a 4-stroke cycle engine usually reveals itself by knocking, squealing and laboring of the engine. If the piston is not pulled at once, the pin may freeze in the bearing, making it almost impossible to remove the pin without damaging the piston.

Piston rings. When removing rings from the piston, do not open them any more than necessary because excessive opening sets up stresses in the ring and may ruin ring tension. Use a ring tool if one is available. If not, insert small strips of shim stock under the ring in about four places around the piston to slide ring off piston. Hacksaw blades broken into suitable lengths may be used for this purpose if the teeth are first ground off and edges smoothed, but do not use them unless this has been done. When badly stuck piston rings cannot be loosened by soaking in a solution, they must be broken out. Pry the ring out with a blunt tool that fits into the groove. Use extreme caution to prevent damage to groove.

Rings should have side clearance of about .001 in. per in. of cylinder diameter for small engines, and .00075 in. for larger engines. To measure clearance, place the ring in its proper groove and with a feeler gage measure clearance between it and the ring land. Ring should be rolled all the way around the groove to make sure it is free and that there is no possibility of its binding. If rings have insufficient side clearance they may be rubbed down slightly on a piece of plate glass or a fine sheet of emery cloth, which has been stretched over a smooth surface.

To measure ring end clearance, place rings in smallest part of cylinder and check gap between their ends with a feeler gage. Adjust rings that have too little clearance by filing down their ends with a fine file, which must be done carefully. Gap clearance of piston rings is of the greatest importance because if gap is too small, rings are sure to break and score the cylinder, whereas if gap is too great, blowby occurs. Ring gap should be about .004 in. per in. of cylinder diameter on square-cut rings, and .0025 to .003 in. for bevel-cut rings. Fig. 3*A*, *B* and *C* illustrate clearances.

Gas leakage past the piston may be due to excessive wear of the ring, lining up of ring gaps, scoring of rings from poor lubrication, damaging of rings during installation, wear of ring groove, sticking of rings, loss of proper ring tension, or broken rings. If ring groove is worn, turn it larger in a lathe and install a wider ring. Fig. 3*D*.

Ring-Trouble Signs

First indication of ring trouble is generally blowby. In large engines it may be heard when the engine is running, while in smaller engines it may be told by power loss, excessive lubricating oil consumption, and excessive smoke and fumes from the crankcase breather.

Reinstalling piston. When reinstalling a piston, place the ring funnel over the cylinder and coat it and the cylinder walls with lubricating oil. Piston is then rubbed well with oil and inserted carefully into the cylinder. Take the greatest care that foot of connecting rod does not strike cylinder wall and score it. Connecting rod should be guided as piston starts to enter cylinder so that rod will seat properly on the crankpin without chipping or denting it. Before rod has seated, coat the crankpin and its bearing with lubricating oil. After rod is in place, bolt up the bearing and jack over the engine to make sure everything is free.

INDEX AVAILABLE

Copies of the index for 1944 POWER will be available about Feb. 15. Because of the paper shortage, it will be impossible to make any general distribution but single copies may be obtained, while they last, by addressing a request to M Coffey, POWER, 330 West 42nd Street, New York, N. Y.

Replacing Old Pumps With New Ones

Pumps that are more than ten years old can frequently be replaced by modern ones that pay off their installation price in one to two years in reduced power and operating costs. H P Binder, manager of the centrifugal pump department, Allis Chalmers Manufacturing Company, shows how higher speed, improved efficiency and compact design make this possible

► AMONG THE power wasters in industry are thousands of obsolete pumps, many of which are 20, 30 and even 40 years old. Under wartime restrictions it is not possible to retire these antiques but when normal conditions return they should be well up on the "must" list to be replaced by modern and efficient equipment.

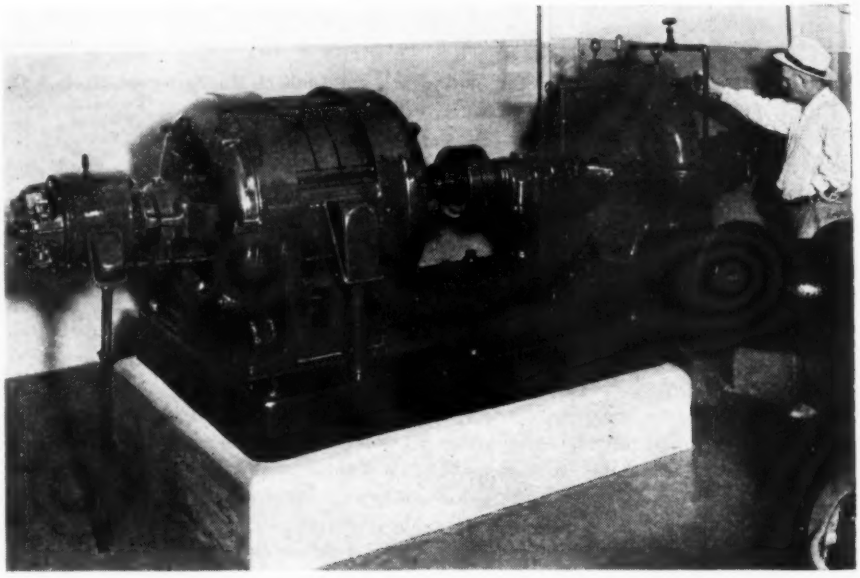
Centrifugal pumps have been so improved during the last two decades as to make it economical to replace many older designs. Power savings due to the higher efficiency of the new pumps pay their cost in a short time. A gain in efficiency of 10 to nearly 20% can be expected from new centrifugal pumps over those that are 15 to 20 years old. What this means in savings depends on the cost of power and number of hours per year that pumps operate.

How Savings Are Made

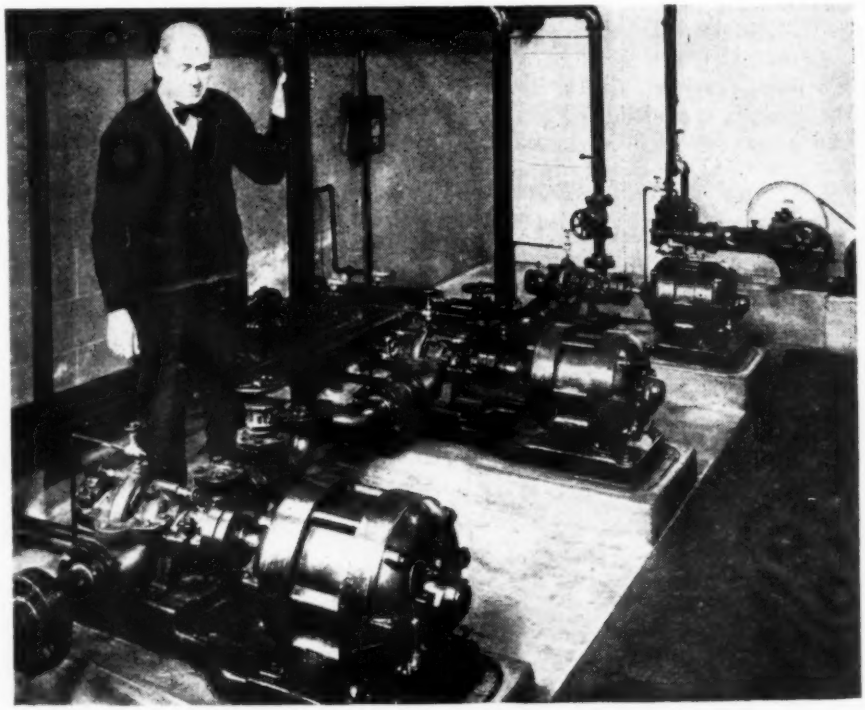
Assume a 1200-gpm 15-year-old centrifugal pump for a 200-ft head. Such a unit has an efficiency of about 72% and requires 84 hp to drive it. A modern centrifugal pump for the same capacity and head has an efficiency of about 84% and requires 72 hp to drive. The old pump requires a 100-hp motor whereas the new one needs only 75 hp. Input to the old pump is about 70 kw and the new one, 59 kw, a saving of 11 kw each operating hour.

For 3000-hr-per-yr operation, power saving equals 3000x11 = 33,000 kwhr, which at 2¢ per kwhr represents a saving of $660.00. This is about 50% of the price for a new pump and motor; that is, the power saving will pay for a new pump in less than two years under the assumed conditions. On 2000-hr-per-yr operations, reduction in power costs pays for the pump in three years, after which the saving is a profit. Experience shows that it is common for new centrifugal pumps to pay off their price in two years by reducing power cost below that for old ones.

Until recently small capacity and high head were obtained with reciprocating or multi-stage centrifugal pumps

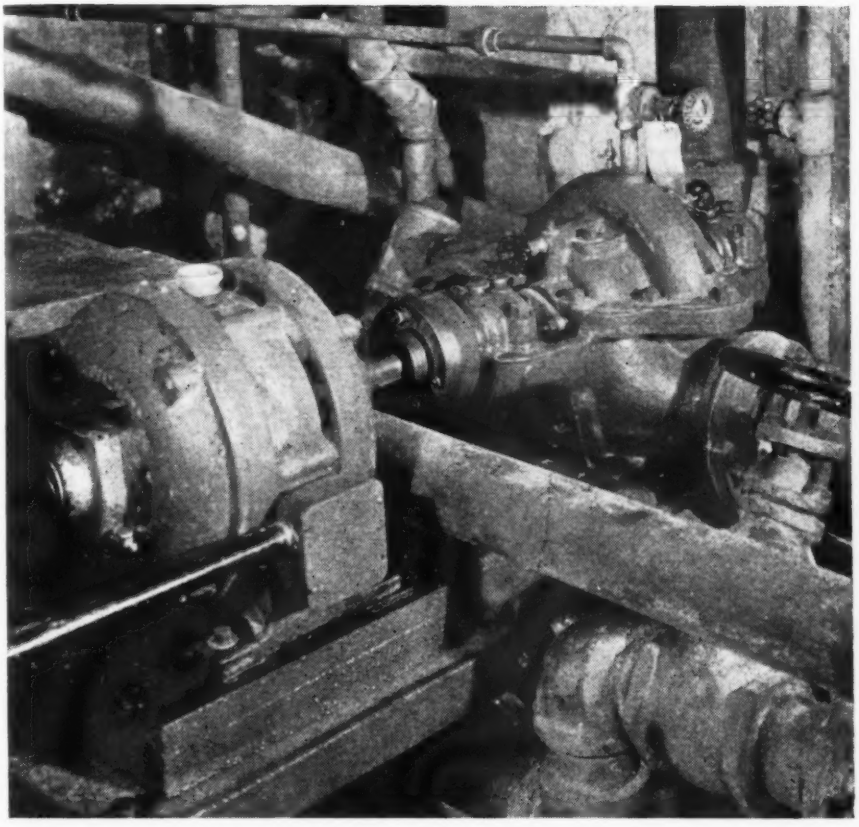


Bottom-suction 7000-gpm 150-ft-head centrifugal pump driven by a 350-hp synchronous motor operates on 0.506 kwhr per 1000 gpm delivered to a city water system

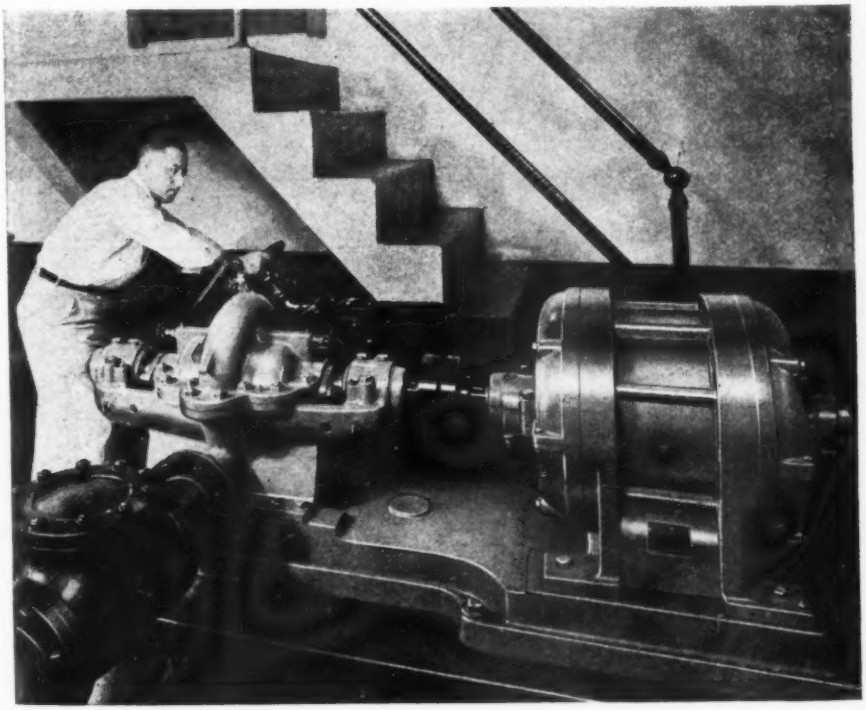


These three centrifugal pumps, two rated 350 gpm and one 250 gpm and 150-ft head, save $6372 per year by replacing old reciprocating pumps in a city waterworks

Cuts Power and Operating Costs



Rated 700 gpm and 50-ft head, this new pump in a paper mill requires only 26 hp compared to 65 hp for an old 450-gpm unit that it replaced, saving over $3000 a year



This 1000-gpm centrifugal pump driven by a 75-hp 1750-rpm squirrel-cage induction motor replaced an old slow-speed pump and saved $2400 per year in operating costs

operating at comparatively low speed. Single-stage centrifugal or other rotating pumps can now take care of heads up to several hundred feet. They operate at comparatively high speed, have good efficiency for their capacity and require only a small part of the space needed by a comparable reciprocating pump.

Modern centrifugal pumps usually operate at higher speeds and have fewer stages than older units for comparable capacities and heads. This has resulted in a simpler construction and lower first cost for the new than for the old, as well as for their spare parts. Because of these changes a new rotating element for a 15-year-old centrifugal may cost almost as much as a new pump of equal rating. Therefore before you repair an old pump, consider buying a new one, and toward the purchase price credit the estimated cost for repairing the old unit.

New Pumps Are Smaller

Many modern centrifugal pumps operating at 3500 rpm combine with their driving motor to form a compact unit; consequently their dimensions are much smaller than the old slower-speed units with pump and motor coupled on a bedplate. Not only is the motor size reduced because of its higher speed, but frequently improved pump performance permits a lower horsepower motor than for an older pump. For example, where an old pump requires a 10-hp motor to drive it, a modern pump of equal rating may need 7.5 hp only.

Many centrifugal pumps are now designed for a specific service. The older designs of sewage pumps were not much different from those for pumping water except they were oversized with slow-speed impellers to prevent clogging. Modern pumps for this service are especially designed to handle sewage. They have nonclogging impellers with large clearances to pass solids, and handholes in their suction make cleaning and inspection easy.

What is true of sewage pumps applies also to pumps for paper stock and similar materials. Many of them have impellers with combined-screw-and-radial streamlined vanes for handling paper stock of high consistency. The screw part of the impeller extends into

(*Continued on page* 158)

Steam-Jet Thermocompressors Supply

If you want some steam at 25 psi and have available exhaust steam, with boiler pressure of 100 psi or higher, the jet is your answer. Philip Freneau, ejector specialist, Worthington Pump & Machinery Corp, describes this mechanically simple device, tells how to use it

► MOST INDUSTRIAL-POWER and chemical plants suffer more or less from unbalance between pressure levels available at the boiler plant and those required for process. Plants that require steam at an intermediate pressure above waste level (but materially less than boiler pressure) waste fuel when they throttle directly from the upper level and discard low-level heat as unusable. Low-pressure steam can be utilized if it is compressed by mechanical means, or, as detailed here, by thermocompressors.

Basic cross-section of a steam-jet thermocompressor is shown in Fig. 1. Its seven parts must be accurately machined and aligned or its performance is seriously impaired. Care must also be used in cleaning and reassembling the unit as position of nozzle with respect to diffuser is often critical and the accidental omission of a gasket on the nozzle, extension, body or nozzle plate may change the jet characteristic.

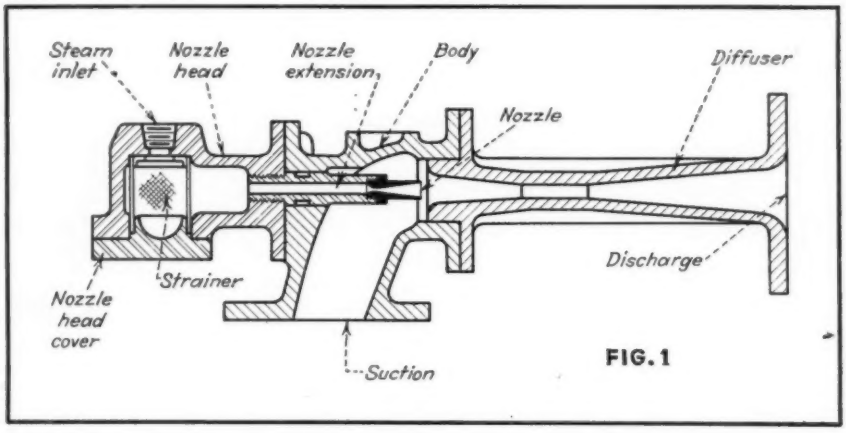
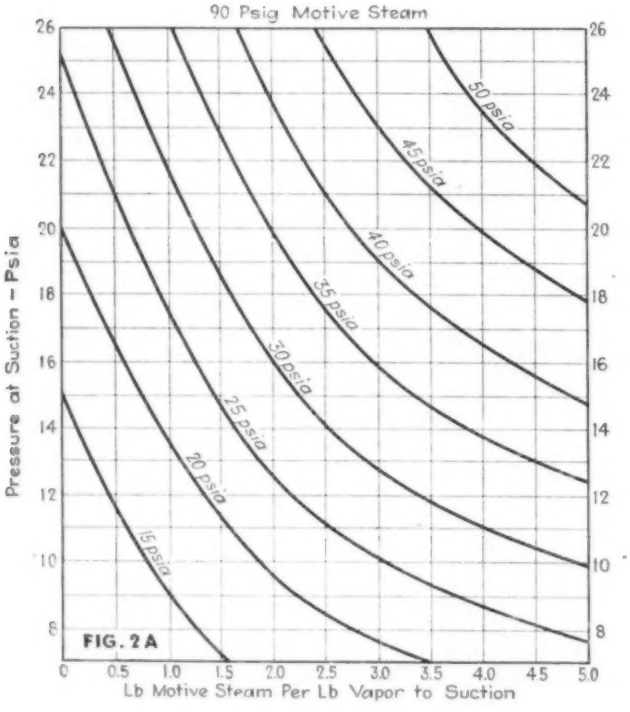


Fig. 1—Basic steam-jet thermocompressor has a total of seven parts, must be accurately machined and aligned for fully satisfactory performance. High-pressure steam expands through a nozzle, entrains low-pressure steam and compresses it

Operation is simple in principle. High-pressure steam expands through a deLaval-type nozzle acquiring a high velocity and entraining vapor from the suction. The mixture enters a converging-diverging diffuser where its velocity is largely reconverted to a discharge pressure higher than suction pressure but materially less than motive-steam pressure. Since the only actual



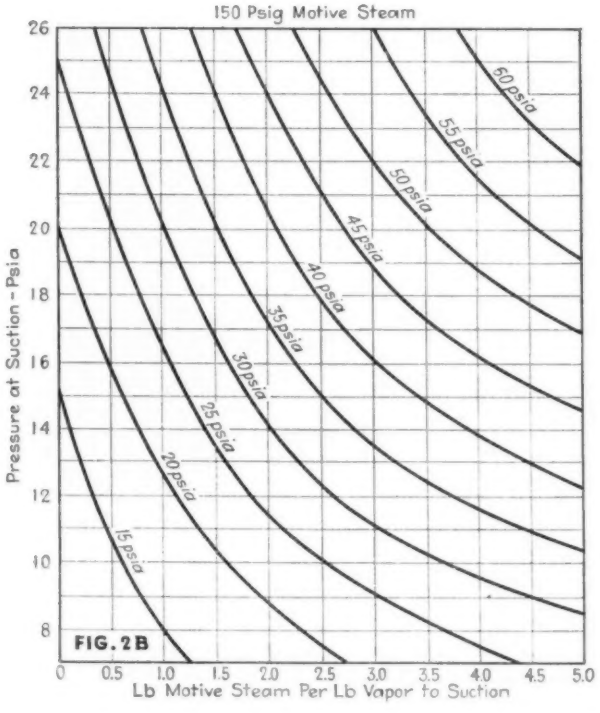


Fig 2—Charts *A* and *B* (*above*) and *C* (*left, facing page*) show amount of motive steam required per lb of vapor at thermocompressor suction for a range of suction and process pressures. For motive pressures other than those indicated,

Intermediate-Pressure Processes—I

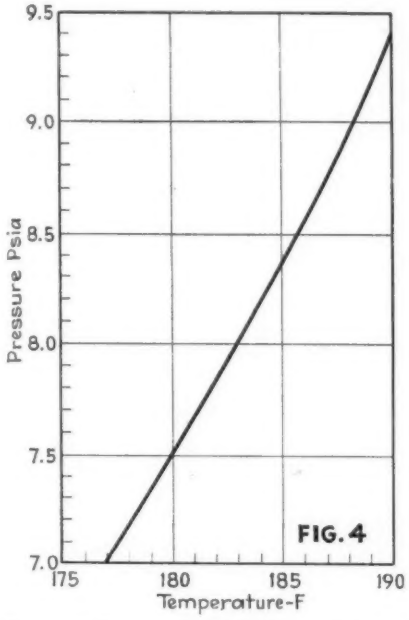


Fig. 4—Temperature-pressure relation from steam tables. Curve shows boiling point at various absolute pressures

TABLE I—CALCULATION FORM FOR MOTIVE STEAM

Suction pressure, psia	*Temp.* F*	*Temp drop, F*	*Lb vapor per hr*	*Lb steam per lb vapor***	*Motive steam, lb per hr*	*Steam plus vapor, lb per hr*
8.0	182.9	7.1	1798	5.10	9160	10,958
8.1	183.5	6.5	1647	5.02	8250	9897
8.2	184.0	6.0	1520	4.93	7480	9000
8.3	184.6	5.4	1368	4.84	6610	7978
8.4	185.2	4.8	1215	4.71	5750	6965

*From Fig. 4 **From Fig. 3

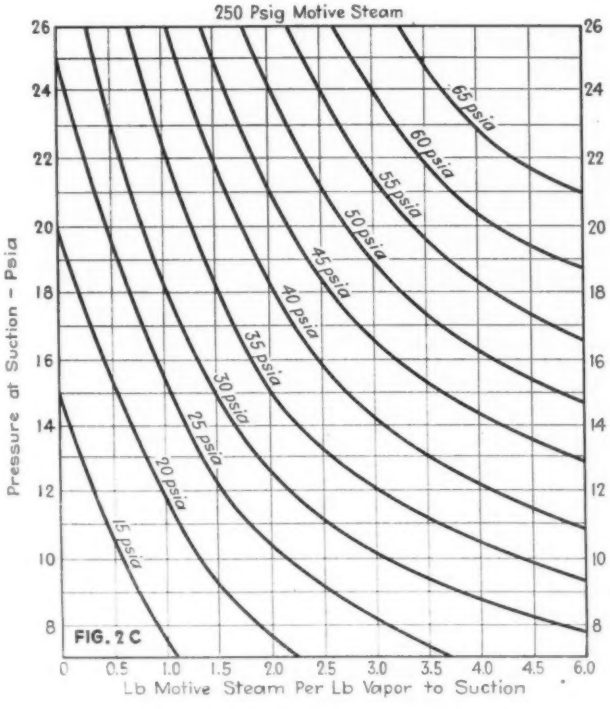
heat loss is through radiation, thermal efficiency is high.

This device can be regarded as a working throttle valve having fair mechanical efficiency when operating under design conditions. Complaints about the efficiency of a thermocompressor can usually be traced to operation beyond the limits for which the jet was designed, effects of which will be detailed later.

Fig. 2 shows amount of motive steam required per lb of vapor compressed for various suction and discharge pressures. The three charts are plotted for 90-, 150- and 250-psig motive steam. For other intermediate pressures it is correct to cross-plot the data (Fig. 3, for example). These values are correct only for the design point of an actual compressor.

Typical examples best illustrate use of these curves. Suppose motive steam is available at a pressure of 150 psig and low-pressure steam can be taken from exhaust header at 5 psig or 19.7 psia. Wanted: 50,000 lb per hr at 20 psig (34.7 psia). Refer to (Fig. 2) chart for 150 psi and move horizontally along the 19.7 psia line to the 30-psia curve. Read 1.07 lb on the base scale. The 35-psia curve yields a value of 1.59 lb on the base scale. Interpolating gives 1.56 lb of motive steam per lb of suction vapor for 34.7-psia discharge.

For 50,000 lb per hr required, entrained vapor is 50,000 ÷ (1 + 1.56)



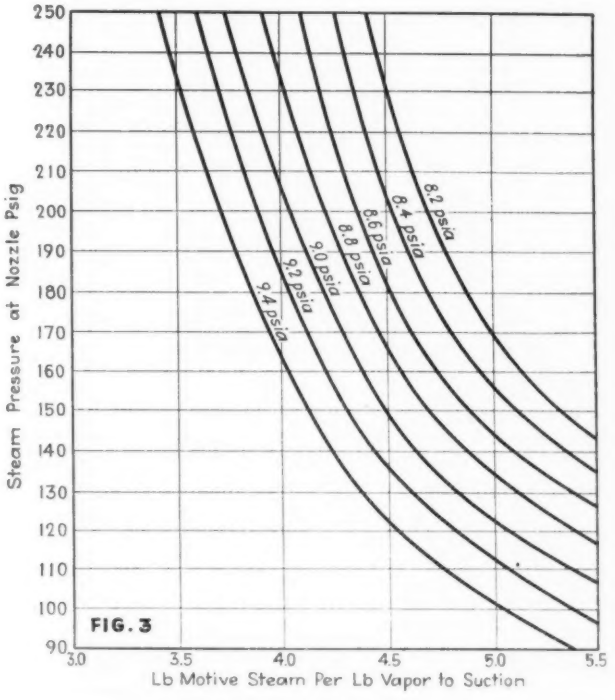


Fig. 3—Cross-plot of data of Fig. 2, for a constant discharge pressure of 29.7 psi absolute, to establish the conditions for cross-plot values from these charts, as shown above in Fig. 3. an intermediate motive-steam pressure

= 19,500 lb per hr. Motive steam is then 19,500x1.56 = 30,500 lb per hr.

Another quite different case occurs when hot water can supply the low-level heat. Suppose 500 gpm of 190-F water is available, motive-steam pressure is 175 psig and 8000 lb per hr of 15-psig (29.7-psia) steam is needed. How much motive steam is required and to what temperature will the water be cooled?

Latent heat of vaporization at 190 F (from the steam tables) is 985 Btu per lb. At 180 F the value is 991.2 Btu. An average over the 10-F range would be 988.1 Btu per lb. Since 500 gpm is (very closely) 500x60x8.33 = 250,000 lb per hr, the water will flash 250,000 ÷ 988.1 = 253 lb per hr of vapor for every degree cooled.

Thermocompressor suction pressure depends on final temperature of hot water after flashing. A simple curve, like Fig. 4, can be plotted directly from the steam tables for finding pressure of vapor when temperature is known.

Using Fig. 2, redraw the data for motive-steam pressure against lb motive steam per lb vapor, as in Fig. 3, for various suction pressures. Discharge pressure is constant at 29.7 psia. The curve of Fig. 3 has been plotted for a much greater range of pressures than required for this problem simply to show the shape of the plot. Now use values from the 175-psig horizontal line to prepare Table I. From the last column it will be seen that 8000 lb per hr total requirement corresponds to about 6600 lb per hr of motive steam and 1400 lb per hr of vapor from the hot water, which is cooled to about 184.5 F. If greater accuracy is required, a second approximation can be made but the corrections are small and hardly justified for most purposes.

This example illustrates recovery of heat from a source often overlooked, namely waste hot water. The calculations to determine how much primary steam can be saved in a particular case are somewhat lengthy but not difficult with the data of Fig. 2 available.

Most compressor applications involve variation in suction, discharge and even motive-steam pressures as well as variation in required flow. Thermocompressors differ considerably from conventional steam-jet ejectors. To predict operation under varying conditions entails some study of thermocompressor characteristics; curves shown for particular applications are illustrative only.

Fig. 5 illustrates a typical thermocompressor performance curve in percent of design conditions. The solid curve of percent capacity against percent suction pressure indicates stable operation, which is produced as long as system pressure is less than maximum safe discharge pressure. On the right, the solid curve indicates maximum safe discharge pressure. As long as system pressure does not exceed values of this curve, a given capacity always produces the same suction pressure.

Usually, however, there are times when system pressure exceeds maximum safe discharge value. Vertical lines indicate various system pressures typical of varying plant requirements. Under certain loads and suction pressures, to the right of and below the curve, these system pressures exceed maximum safe discharge pressure, resulting in unstable operation. It is, of course, proper to operate a thermocompressor in the unstable region if an efficiency loss is acceptable. Horizontal dash lines connect the discharge curve with the capacity curve to show capacity at which the unit breaks. Dotted curves indicate the region of unstable operation and show that the higher the system pressure the greater the departure from the stable curve at light loads.

These conditions are likely to be met in actual operation and it is often desirable to vary system pressure to meet changing requirements. For maximum efficiency the unit must be designed to work against the highest expected system pressure. However, if maximum system pressure occurs only rarely, it may prove economical to design for normal conditions and be reconciled to operating unstably when peak system pressures occur. Fully stable operation can be produced by reducing system pressure as load drops. *Editor's note: Part II, discussing effect of varying motive-steam pressure, method of control, parallel operation and typical installation hookup will appear in an early issue of* POWER.

Some Thermocompressor Definitions

Suction condition—Physical and thermal condition at the low-pressure end of the unit between suction valve and point in the body where entrainment occurs.

Discharge condition—Physical and thermal condition at discharge end of the unit between discharge flange and discharge valve.

Motive-steam condition—Physical and thermal condition between throttle valve and nozzle inlet.

Pressure—Suction and discharge pressure may be expressed in inches of mercury absolute (in. Hg abs) or lb per sq in. absolute (psia). Motive steam pressure is here expressed in lb per sq in. gage (psig).

Stability—A thermocompressor is stable when neither increase in steam pressure nor decrease in discharge pressure can cause a decrease in suction pressure for a given vapor load to the suction.

Safe pressures—Maximum discharge pressure or minimum steam pressure for stable operation.

System pressure—Actual pressure maintained at compressor discharge including allowance for loss through valves, piping and fittings.

Break—Point at which operation passes from stable to unstable.

Pickup—Point at which operation passes from unstable to stable.

Fluctuation—Cyclic variation in pressure.

Bobble—Rapid variation in pressure.

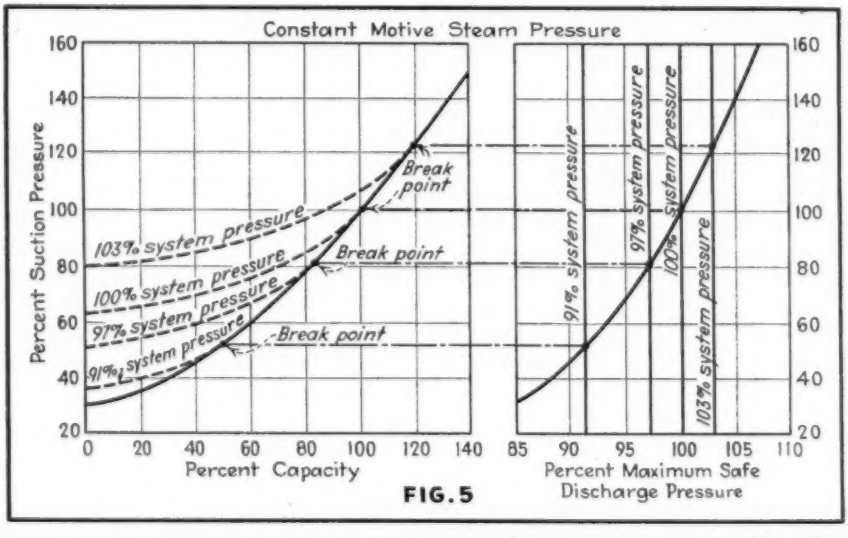


Fig. 5—For constant motive-steam pressure, a thermocompressor is stable when suction pressure and capacity display values corresponding to the solid line at left. At right, the curve indicates maximum safe discharge pressure

Sure-Fire Forms For Combustion Calculations

1—SOLID AND LIQUID FUELS

Glenn C Boyer, associate engineer, Burns & McDonnell Engineering Co, presents a new combustion form you can't forget how to use because all operations are indicated and all needed constants are included. For any solid or liquid fuel this convenient form gives theoretical air and CO_2 percentage. It also gives actual CO_2 for various amounts of excess air

▶ MANY CLEVER TABLES and short cuts have been developed to speed or simplify combustion calculations. Despite their admitted good points, most of these "helps" have one serious drawback; the engineer who uses them only now and then can easily forget how to use them.

The form presented here is arranged for speedy and easy calculation. More important, it is almost self explanatory. With the aid of the examples here worked out, you can pick it up after several weeks disuse and quickly recall where to enter what data, what to multiply by which factor, etc.

This form works from the ultimate analysis (by weight) of the fuel, and will fit any solid or liquid fuels. A later article will present a similar arrangement for gas fuels.

First set down under ultimate analysis the weight of each listed element in one pound of fuel. Thus, if carbon is 83.39, write down the number 0.8339. Enter the same value in the column B in the middle tabulation of the form.

Succeeding procedures are entirely mechanical:

1. Calculation of theoretically correct weight of air to burn one pound of the fuel.

1 Combustion Calculation Sheet

Solid and Liquid Fuels

FUEL COAL SOURCE WEST VIRGINIA-ASHLAND (M'Dowell County)

Ultimate Analysis:

Carbon	C	0.8339
Hydrogen	H_2	0.0456
Oxygen	O_2	0.0505
Nitrogen	N_2	0.0103
Sulphur	S	0.0064
Ash		0.0533
		1.000

Heating Value 14,550 Btu As Received

Moisture 2.80 %

*Includes N_2 in Air (*below*)

Element A	Weight B	Oxygen Determination Factor C	Oxygen Determination Weight O_2 D=BxC		Weight Prods E=B+D	Volume Factor F	Volume at 60F G=ExF
C	0.8339	2.67	+ 2.22	CO_2	3.05	8.61	26.2 (1)
H_2	0.0456	8.0	+ 0.37	H_2O	0.416		
O_2	0.0505	−1.0	− 0.05				
N_2	0.0103			N_2	*8.43	13.53	114.0 (2)
S	0.0064	1.0	+ 0.006	SO_2	0.012	5.92	0.07 (3)
							140.27 (4)

Weight O_2 Required = 2.546
N_2 in air = 3.31 x O_2 = 8.42
Weight Air Required = 10.966

Vol Dry Prods = 140.27 (4)

% CO_2 = (1)/(4) = 26.2/140.27 = 18.65%

Excess Air % a	Excess Air Weight b	Factor c	Volume Excess Air d=bxc	Volume Dry Prod e=(4)	Volume Total f=d+e	Volume CO_2 (1)	% CO_2 (1)/f
0	0	13.09	0	140.27	140.27	26.2	18.65
20	2.18	13.09	28.50	140.27	168.77	26.2	15.52
40	4.36	13.09	57.00	140.27	197.27	26.2	13.30
60	6.55	13.09	85.50	140.27	225.77	26.2	11.61
80	8.73	13.09	114.00	140.27	254.27	26.2	10.30
100	10.96	13.09	143.20	140.27	283.47	26.2	9.26

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Table 1—The form is for any solid or liquid fuel; in this example, coal. Indicated steps give theoretical air, theoretical CO_2, and actual CO_2 percentage for various percentages of excess air. Write down the coal analysis at top left in terms of weight of each constituent. Thus, 83.39% carbon is written 0.8339. Column *B* repeats this. Multiplying items in column *B* by factors in column *C* gives 2.546 oxygen required, column *D*. Multiplied by 3.31, and adding 2.546, gives 10.966 lb air. Add *B* and *D* to get *E*. Then multiply by factors in *F* to get gas volume *G*, here totaling 140.27. Theoretical CO_2 percentage is item (1) divided by item (4), here 18.65%. Bottom item in column *b* is 100% of 10.96, the required weight of air already figured. Other items in *b* are 0, 20, 40%, etc, of 10.96. Column *b* x 13.09 gives column *d*. Column *e* is item (4) from column *G*. Column *f* is *d* plus *e*. Column (1) is item (1) in column *G*. Percent CO_2 in the final column is (1) divided by *f*.

2. Calculation of percent CO_2 resulting from the combustion with theoretical air.

3. Calculation of percent CO_2 resulting from combustion with varying amounts of air in excess of the theoretically correct amount.

Theoretical Air

After the weights of elements comprising the fuel are entered in column B, next step is to calculate the weight of oxygen required. Multiply the values in column B by the constants in column C and write the products in column D. Since nitrogen is an inert gas, and has no effect on combustion, it does not enter into the theoretical oxygen calculation.

Note that the oxygen factor is −1, giving a corresponding minus value in column D, because any oxygen in the fuel *decreases* the outside oxygen required.

Next, determine the total weight of oxygen by adding the computed values in column D, taking care to account for plus and minus values. In the first example (Table 1) 2.546 lb of oxygen is the theoretical requirement per pound of fuel.

Next step is to compute weight of nitrogen in the air necessary to provide 2.546 lb of oxygen. This is 3.31x2.546 = 8.42 lb. Added to the 2.546 lb of oxygen, it gives 10.966 lb of air theoretically required for combustion.

Theoretical Percentage CO_2

Next find the percentage CO_2 for the theoretically correct amount of air. Weights of the products of combustion of the carbon (C), hydrogen (H_2) and sulphur (S) are first computed by adding the values in columns B and D and entering results in column E. To get the resulting nitrogen (N_2) in the flue gas, add weight of N_2 in column B to weight of N_2 in the air (in this instance 0.013+8.42) and enter 8.43 in column E.

Since the values in column E are weights, and since actual analysis of the flue gas is always on a volume basis, it is necessary to convert from weight to volume. In this calculation weight of the water formed is neglected because the orsat analysis gives the CO_2 as a percentage of the *dry* products of combustion. All volume factors are based upon a temperature of 60 F to simplify calculation.

To calculate the volume of each dry constituent multiply its weight, column E, by its volume factor, column F, and enter results in column G. Only items (1), (2) and (3) are thus calculated, and the sum of these three in column G is the volume of dry products, item (4) (here 140.27). To determine the percent CO_2 for the theoretically correct amount of air, divide item (1) by item (4). In the example this is 26.2 ÷ 140.27 = 18.65%.

CO_2 Versus Excess Air

Finally, calculate the relationship between excess air and percent CO_2 using the tabular form at the bottom of the sheet. To figure weight of excess air (column *b*), multiply the "Weight Air Required" immediately above (here 10.966) by the percentages in column *a*, setting down the results in column *b*. Multiply these values in column *b* by the factor 13.09 (column *c*) and enter results in column *d*.

Volume of direct dry products, column *e*, is item 4 of column *G* above. Total volume of dry products is the sum of columns *d* and *e*, and is entered in column *f*. In column (1) enter the volume of CO_2 from item (1) column *G*, above. Divide (1) by *f* to get the corresponding percentage of CO_2 (last column).

While the written explanation will seem somewhat long, the process is readily mastered. Once acquired, it takes only a few minutes. This form can be readily duplicated by mimeographing. The constants are always available *on the form*, so that little memory work is required to use this setup.

The additional examples (Tables 2 and 3) showing the computations for a wood fuel and for a fuel oil illustrate the application to non-gaseous fuels other than coal.

In this form volumes of dry products of combustion were computed for 60 F, which may be viewed as "room temperature." Any other temperature would

② Combustion Calculation Sheet

Solid and Liquid Fuels

FUEL *WOOD - YELLOW PINE* SOURCE .....

Ultimate Analysis:

Carbon	C	*0.5031*	Heating Value ..... Btu
Hydrogen	H_2	*0.0620*	As Received
Oxygen	O_2	*0.4308*	
Nitrogen	N_2	*0.0004*	Moisture ..... %
Sulphur	S		
Ash		*0.0037*	*Includes N_2 in Air (*below*)
		1.000	

Element A	Weight B	Oxygen Determination Factor C	Oxygen Determination Weight O_2 D=BxC		Weight Prods E=B+D	Volume Factor F	Volume at 60F G=ExF
C	*0.503*	2.67	+ *1.345*	CO_2	*1.848*	8.61	*15.8* (1)
H_2	*0.062*	8.0	+ *0.495*	H_2O	*0.557*		
O_2	*0.431*	−1.0	− *0.431*				
N_2	*0.0004*			N_2	**4.66*	13.53	*63.0* (2)
S		1.0	+ *0*	SO_2		5.92	— (3)

Weight O_2 Required = *1.409*
N_2 in air = 3.31 x O_2 = *4.66*
Weight Air Required = *6.069*

Vol Dry Prods = *78.8* (4)

% CO_2 = (1)/(4) = *15.8* / *78.8* = *20.0%*

Excess Air % a	Excess Air Weight b	Factor c	Volume Excess Air d=bxc	Volume Dry Prod e=(4)	Volume Total f=d+e	Volume CO_2 (1)	% CO_2 (1)/f
0	*0*	13.09	*0*	*78.8*	*78.8*	*15.8*	*20.0*
20	*1.215*	13.09	*15.9*	*78.8*	*94.7*	*15.8*	*16.7*
40	*2.43*	13.09	*31.8*	*78.8*	*110.6*	*15.8*	*14.3*
60	*3.64*	13.09	*47.6*	*78.8*	*126.4*	*15.8*	*12.5*
80	*4.85*	13.09	*63.4*	*78.8*	*142.2*	*15.8*	*11.1*
100	*6.07*	13.09	*79.5*	*78.8*	*158.3*	*15.8*	*10.0*

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Table 2—Here the form and method of computation are exactly the same as explained for coal in Table 1, but the fuel considered is wood. As before, the main quantities determined are theoretical air, theoretical CO_2 and actual CO_2 corresponding to various percentages of excess air

have served as well. Flue gas leaves the boiler at a temperature anywhere from 450 to 800 F. If the actual volume of the dry products of combustion at the existing gas temperature is desired, multiply the individual (60 F) volume concerned by $\frac{460+T}{520}$ where T is the temperature of the exit gas. This factor, for a few of the possible temperature values, is:

Temperature—F	*Factor*
400	1.66
450	1.75
500	1.85
550	1.95
600	2.04
700	2.23
800	2.42

A subsequent article will cover calculations involving natural gas, sewage gas and manufactured gases. Here a new computation form will be required because the analysis of fuel gas is customarily given in percentages by volume rather than in percentages by weight.

③ Combustion Calculation Sheet

Solid and Liquid Fuels

FUEL *FUEL OIL* SOURCE .....

Ultimate Analysis:

Carbon	C	*0.840*	Heating Value *18,700* Btu	
Hydrogen	H_2	*0.127*		As Received
Oxygen	O_2	*0.012*		
Nitrogen	N_2	*0.017*	Moisture *0.0* %	
Sulphur	S	*0.004*		
Ash			*Includes N_2 in Air (*below*)	
		1.000		

Element A	Weight B	Oxygen Determination Factor C	Oxygen Determination Weight O_2 D=BxC		Weight Prods E=B+D	Volume Factor F	Volume at 60F G=ExF
C	*0.84*	2.67	+ *2.24*	CO_2	*3.08*	8.61	*26.55* (1)
H_2	*0.127*	8.0	+ *1.02*	H_2O	*1.147*		
O_2	*0.012*	−1.0	− *0.012*				
N_2	*0.017*			N_2	*10.777*	13.53	*145.90* (2)
S	*0.004*	1.0	+ *0.004*	SO_2	*0.008*	5.92	*0.05* (3)

Weight O_2 Required = *3.252* | Vol Dry Prods = *172.50* (4)

N_2 in air = 3.31 x O_2 = *10.76* | % CO_2 = $\frac{(1)}{(4)}$ = $\frac{26.55}{172.50}$ = *15.4 %*

Weight Air Required = *14.012*

Excess Air % a	Excess Air Weight b	Factor c	Volume Excess Air d=bxc	Volume Dry Prod e=(4)	Volume Total f=d+e	Volume CO_2 (1)	% CO_2 (1)/f
0	*0*	13.09	*0*	*172.50*	*172.50*	*26.55*	*15.4*
20	*2.8*	13.09	*36.6*	*172.50*	*209.10*	*26.55*	*12.70*
40	*5.6*	13.09	*73.3*	*172.50*	*245.8*	*26.55*	*10.80*
60	*8.4*	13.09	*110.0*	*172.50*	*282.5*	*26.55*	*9.4*
80	*11.2*	13.09	*146.8*	*172.50*	*319.3*	*26.55*	*8.3*
100	*14.01*	13.09	*183.5*	*172.50*	*356.0*	*26.55*	*7.45*

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Table 3—Once more the method of computation is exactly the same as for coal and wood. Note, however, that the hydrogen in fuel oil makes the theoretical percentage of CO_2 substantially lower than with coal or wood

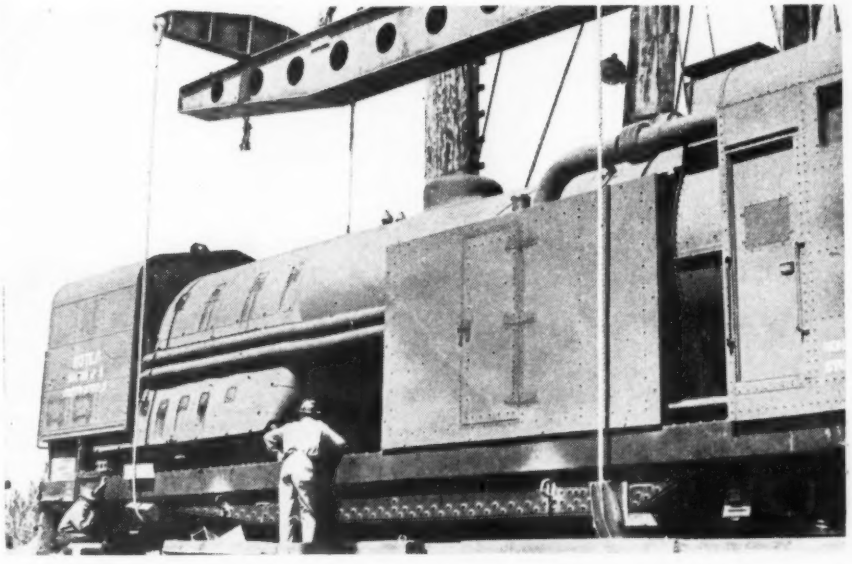
Mobile Plants for Power-Needy USSR

▶ THE PHOTOGRAPH shows part of a recent shipment of General Electric Company's 3000-kilowatt mobile steam power plants which are now on active duty with the combat troops of our ally, the USSR.

Each plant consists of ten cars, which make up a complete power-generating unit. Forty such plants are being supplied to provide electric power in areas devastated by the Axis and later retaken by the steam-rolling armies of the Allies.

Hauled to power-needy sites close behind the fighting lines, the plants can be put into operation within a day. All they need to go into action is a supply of coal and water to complete the required facilities for the ready supply of electrical energy.

General Electric is also supplying 23 smaller mobile plants of 1000-kilowatt capacity each for similar use.



Part of a recent shipment, now in the USSR, of 3000-kilowatt mobile steam plants each consisting of ten cars, which make up one complete power-generating unit

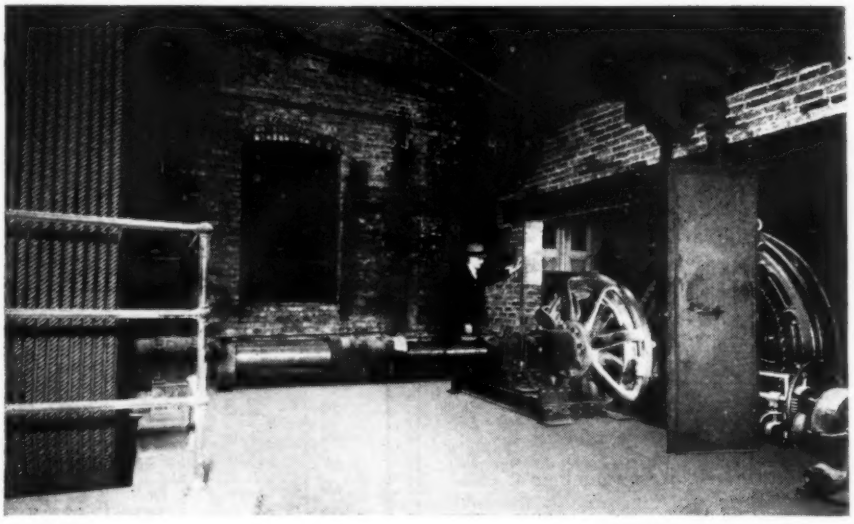
Clutches Make Hard Starting Easy for General-Purpose Squirrel-Cage Motor

Comparing the characteristics of several classes of polyphase ac motors used for hard-starting loads shows that a simple general-purpose squirrel-cage motor with manually operated or automatic clutch may provide the most economical answer for many power applications

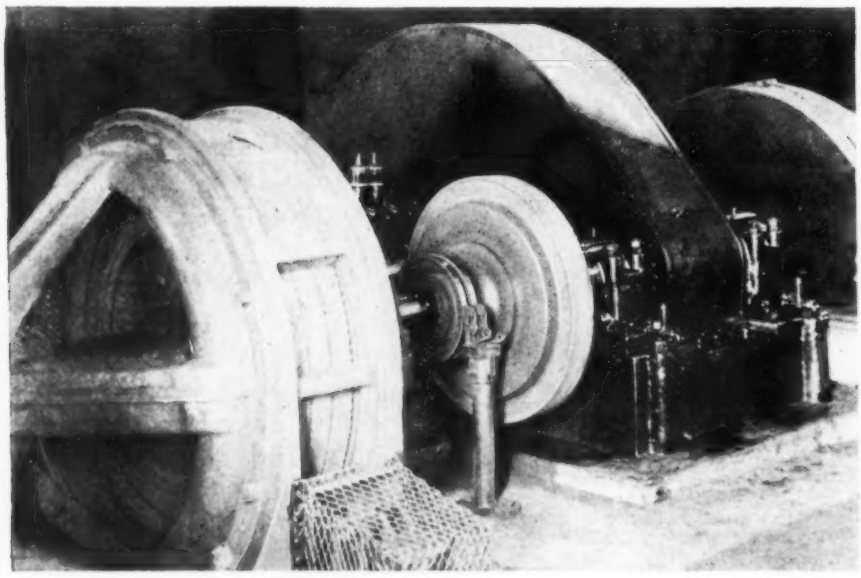
▶ DIFFICULT-STARTING LOADS are driven in several ways from ac power systems. Among the most generally used drives are (1) wound-rotor, double-squirrel-cage and high-starting-torque squirrel-cage motors directly connected to the load and (2) general-purpose squirrel-cage and synchronous motors connected to their load by manual or automatic clutches. Choice depends on starting, accelerating and running requirements.

Wound-rotor motors develop a high starting torque practically proportional to current input, up to 300% full-load value. Torque and input current can be controlled to meet starting requirements. These motors, however, are high in first cost, particularly if they start automatically and their power factor and efficiency are lower and maintenance higher than for a comparable general-purpose squirrel-cage motor.

Double-squirrel-cage motors may also be used on loads where high starting torque is needed. They develop about 250% full-load starting torque at full voltage on 500 to 600% full-load current. Their speed-torque characteristic is generally sufficiently flat to accelerate any load they can start. These motors have higher first cost than comparable general-purpose squirrel-cage motors and have 5% lower full-load power factor and 30% lower pull-out torque.



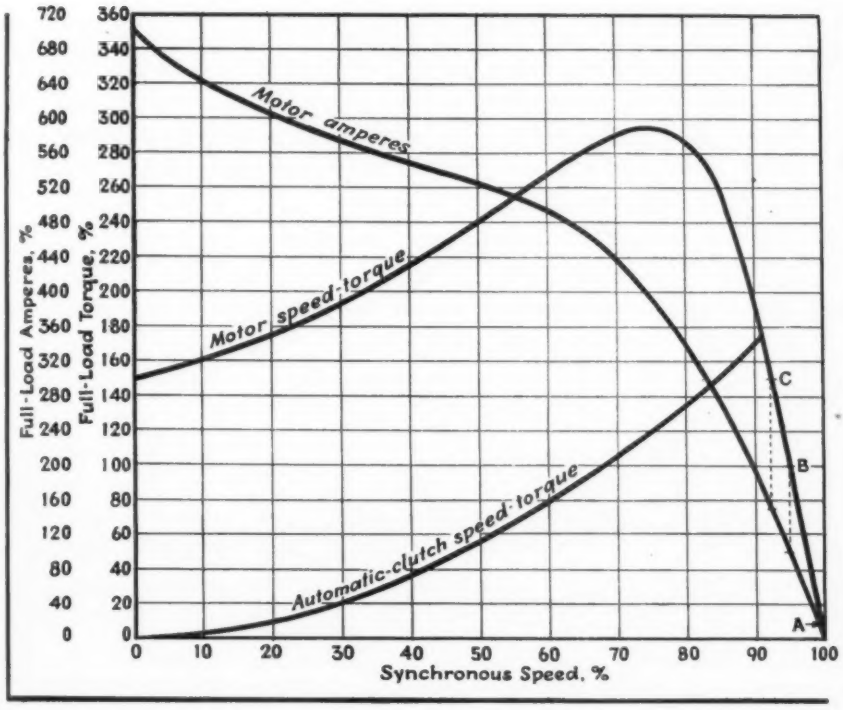
A 60-in. friction clutch permits a 500-hp 109-rpm synchronous motor to be started without load before connecting to a flour-mill lineshaft through Manila-rope drive



A 30-in. magnetic friction clutch between a 150-hp 2300-v squirrel-cage motor and an accumulator reciprocating plunger pump, starts and stops the pump automatically

High-starting-torque ac squirrel-cage motors have characteristics suited to starting and driving high-inertia loads that have flywheels to absorb load fluctuations such as on punch presses. Such motors are available that develop up to over 300% full-load torque at starting with about 500% full-load current. They have a speed-torque curve that develops maximum torque at starting, and generally accelerate any load they can start. Their slip is 10 to 15% compared to 3 to 5% for a general-purpose squirrel-cage motor and an efficiency 5% lower. On punch presses and similar fluctuating loads the motors' high slip permits them to slow down momentarily and let the flywheel absorb part of the shock load of the punch operation.

Frequently difficult-start loads can be most economically powered by simple general-purpose squirrel-cage motors and clutches. These motors are lowest in cost and maintenance, and when un-



Speed-torque and starting-current curves of standard 1800-rpm general-purpose squirrel-cage motor compared to speed-torque curve of automatic friction clutch

loaded may be started directly across the line with a simple magnetic contactor. When designed for 1800 rpm they have a full-voltage speed-torque curve similar to that in the drawing. At starting and rated voltage they develop about 150% full-load torque on 600 to 800% full-load current.

On an easily accelerated load, such as one having low inertia and static friction, their starting current peak may be so short that it does not produce any ill effects in the power system. Under more severe starting conditions, even if the motors can start their loads, acceleration period may be so long as to make the starting current objectionable. In addition, if starting is frequent the heavy starting currents may overheat the motor, unless it is of larger capacity than needed to drive the load.

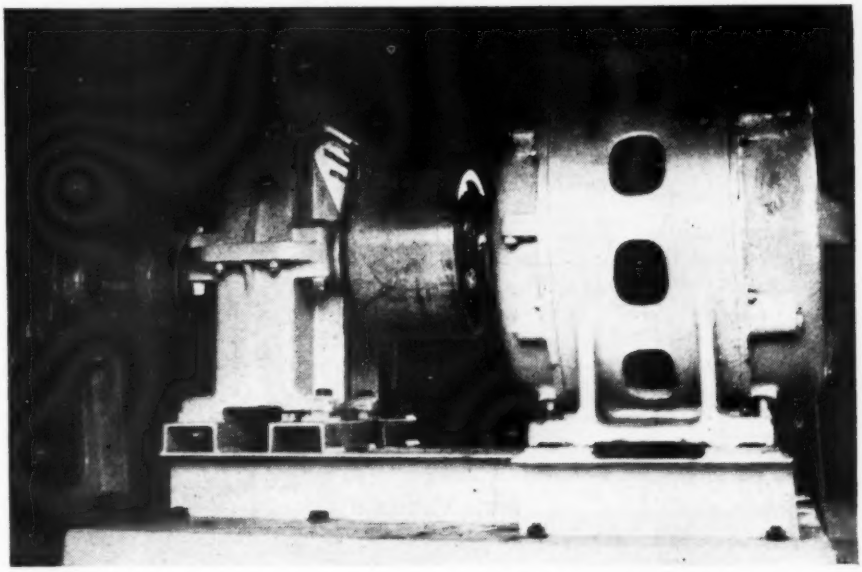
Motor and Clutch

A clutch between the motor and its load eliminates practically all these objections. When clutch is manually operated motor starts completely unloaded and is operating at the no-load point, as at *A*, on its speed-torque curve before load is applied. Starting under these conditions, motor accelerates so rapidly that the starting-current peak has very little effect on the power-system voltage.

When clutch is being engaged to accelerate the load, motor operates from *A* up along the steep part of the speed-torque curve where current is proportional to torque. If necessary an ammeter, in sight of the attendant, may be put in the motor circuit and starting current limited to any desired value that will accelerate the load. For example, starting current may be held at 100% full-load value to apply 100% full-load torque to the load, as at *B*. Or 150% full-load torque can be had with 150% full-load current, as at *C*. If clutch has sufficient capacity any starting torque may be applied to the load up to about 275% full-load rating of the motor, with a comparable starting current.

With an automatic clutch the motor also starts unloaded. Clutch does not apply 100% load to motor until latter has reached about 70% synchronous speed and starting current has decreased to 450% full-load value. When clutch reaches its maximum starting torque of 175% rated load, motor is operating at over 90% synchronous speed and starting current has decreased to 175% full-load value. As a result, general-purpose squirrel-cage motors can handle hard-starting loads with little disturbance to the power system. What has been said about clutches on squirrel-cage motors often applies to synchronous designs.

To operate successfully, clutches must be selected for the conditions under which they are to operate. The greater the number of engagements a clutch has to make, the harder it must work. Consequently, if it is to operate successfully it must be selected with ample capacity. For example, a clutch to connect a 10-hp motor to a steady load with normal start conditions, need be good for only 10 hp, if the clutch has to make one or fewer engagements per hour. When starting is frequent, for instance more than 15 engagements per hour, a clutch of 15-hp rating is required. For shock loads, if the clutch makes one or fewer engagements per hr, a 13-hp clutch should be selected for a 10-hp motor. When engagements are more than 15 per hr, select a clutch that is good for at least 18 hp.



Changing from flexible coupling to an automatic clutch made it possible for this 150-hp synchronous motor to accelerate its mine-fan load to synchronous speed

Blade Cooling Helps Gas Turbines to Higher Temperatures

Prospects of improved efficiency at 1500 F led to this study of cycle operation with cool air circulation inside disk-blade structure of high-temperature element

By JOHN S HAVERSTICK and ARTHUR M G MOODY*
De Laval Steam Turbine Co

▶ THE NUMBER of possible variations of the constant-pressure gas-turbine cycle is enormous and it will be many years before the final test of practical application has ruled out many of them. Meanwhile, a study of most promising elements is in order.

Two schools of thought believe (1) that 1100 to 1200 F represents a practical limit to temperature at least for the present and (2) that 1500 F is now practical by using an impulse stage. Of the former, assuming reaction turbines, some believe the gas turbine commercially feasible right now while others are skeptical.

Recognizing the handsome gain in efficiency inherent in going from 1200 F to 1500 F, we advance a third point of view, namely, the possibility of capturing the efficiency gain without employing an inefficient initial stage by using air from the compressor to cool parts of the turbine normally under high temperature and high stress. Naturally, this too involves some losses of its own.

Of various systems proposed for cooling gas-turbine blades perhaps the crudest is jetting cold air directly against wheel or blade fastenings. Also, with an impulse wheel, relatively cool air can be supplied to a group of nozzles immediately following those that handle hot gas. The latter arrangement develops some useful power from the air and provides fairly effective cooling.

A possible third system involves providing passages within the turbine wheel through which cooling air can flow. Little pressure loss is suffered by the air and excellent cooling is assured. A wheel of the type shown in Fig. 1 is well adapted for internal cooling.

Assuming that a temperature of, say, 1200 F is practical for the cycle represented in Fig. 2 without blade cooling, some higher temperature, perhaps 1500 F, might be practical in the high-temperature section of the gas turbine. Leaving details of metal temperatures and stresses for later study, we show here only a calculation of the possible gain in efficiency and reduction in air rate possible by bleeding the compressor for blade cooling.

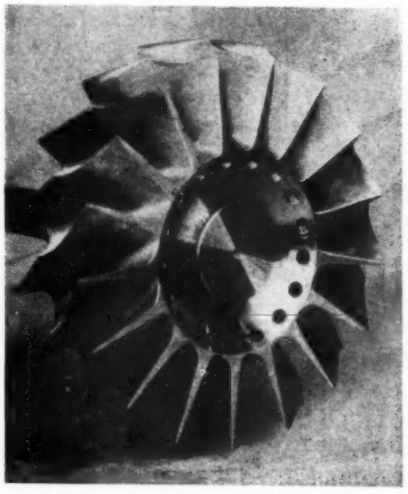


Fig. 1—Turbine wheel with openings for passage of relatively low-temperature air bled from compressor stage

Certain simplifications in the calculations are possible if the entire gas flow from the high-temperature turbine (including cooling air) is assumed to be reheated to a constant temperature, whatever uncooled blades can stand. The cooling-air cycle can then be treated separately as though it never mixed with the main stream but instead was separately heated by burning added fuel to bring temperature to a proper value for the low-pressure turbine.

The cooling air in reality does remove heat from the main stream, reducing the energy available for the low-pressure part of the expansion. However, assume that 1200 F is the maximum initial gas temperature an uncooled turbine can stand. Suppose also that the high-pressure turbine, by cooling, can use 1500-F gas and would, if the cooling air were not admixed, ex-

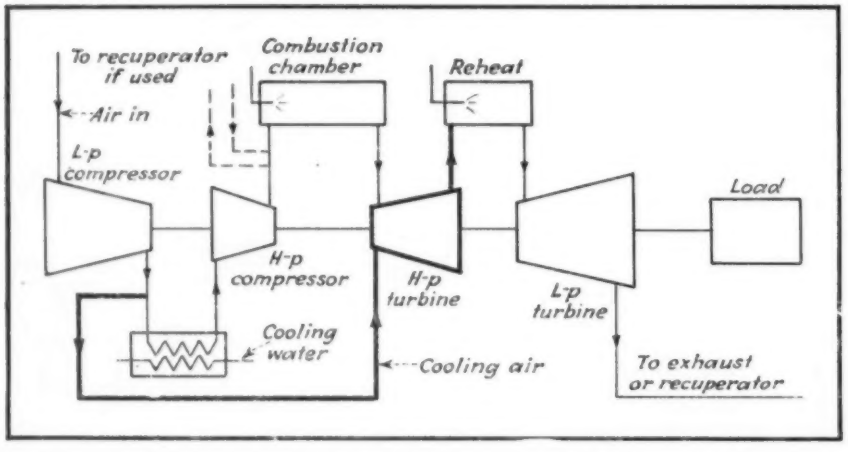


Fig. 2—Combined cycle for 1500 F with air cooling of high-pressure high-temperature blades and reheat of the entire mass flow of gas to constant temperature

* Condensed from a technical paper presented before the American Society of Mechanical Engineers annual meeting Nov. 30, 1944

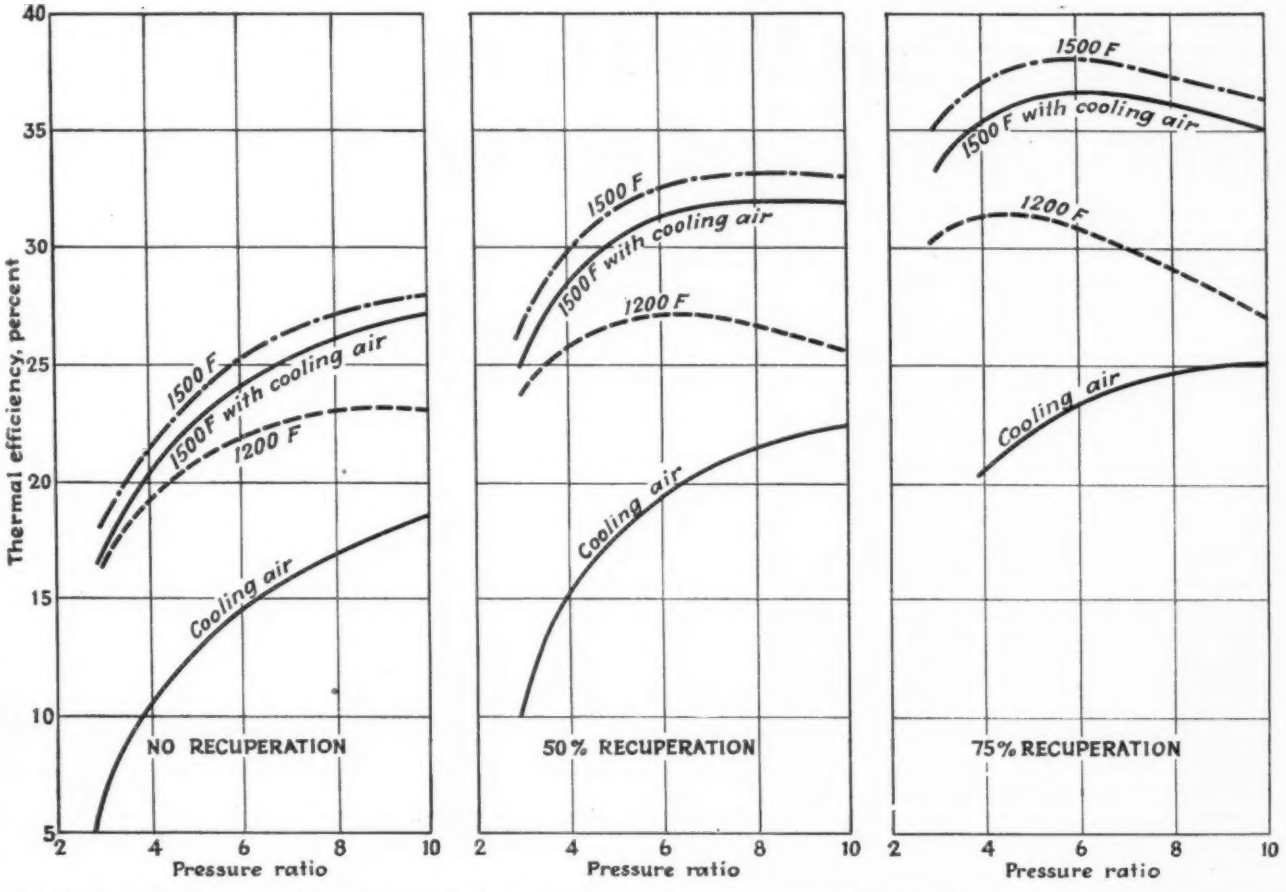


Fig. 3—Thermal efficiency of 1500-F cycle with and without cooling air compared to normal 1200-F performance for simple unit, medium- and large-sized heat exchangers. Note thermal efficiency of cooling air considered alone as separate cycle

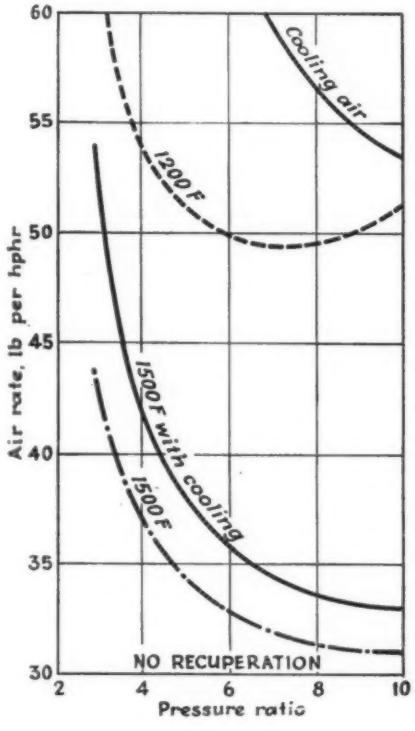


Fig. 4—Lower air rate for high-temperature cycle means smaller and lighter equipment for the same net output or larger outputs from possible machines

haust at 1200 F. Then the amount of fuel necessary to bring the mixed gas stream to 1200 F at the inlet of the low-pressure turbine is the same as would be required to heat the cooling air alone from the temperature at which it enters the turbine wheel to 1200 F.

While treating the two distinct cycles separately involves some differences in actual heat exchange, it does not in any way alter the over-all energy balance, as can be shown somewhat in detail. Dealing with the sum of the outputs of the two cycles and the sum of the fuel inputs, thermal efficiency can be evaluated and represented in chart form as in Fig. 3. Basic blade efficiences and recuperator performance have been assumed at values comparable with other published information; their absolute values are unimportant to the illustration of *difference* between the 1200-F uncooled cycle and the 1500-F cooled cycle.

Cooling-air flow has been assumed at 10% for calculating purposes although experience has shown a value between 4 and 8% reasonable. The smaller the amount of cooling air, of course, the closer the efficiency will come to that for the uncooled 1500-F cycle, included here merely for the sake of comparison.

Gain in efficiency over the 1200-F uncooled cycle is distinctly worth while, particularly with increased amounts of heat-exchanger surface as represented by higher percentages of recuperation. The gain can be accomplished with no additional machine elements, assuming that recuperation and reheat would be used in any high-efficiency application.

Of equal interest to the designer is the improvement in work ratio and air rate. Work ratio is a measure of net output at the generator coupling to the heat-work input to the turbine itself, and the greater the work ratio the smaller and lighter the machinery for a given output. Air rate, net output delivered per lb of air flowing, also measures bulk and weight of machine. It is seen from Fig. 4 that fewer lb of air have to be handled by compressor, turbine and heat exchanger when the cooled cycle is used as compared with the uncooled 1200-F cycle.

It is not intended to recommend use of a cooling cycle for all applications. Where high efficiency must be coupled with light weight, however, the 1500-F cycle with blade cooling offers some worth-while possibilities.

What Operators Should Know About Boiler-Tube Slagging

If slag plugs first pass or superheater, operation may be at fault. Out of long experience with many boiler types, D L Blatter reviews slag-formation fundamentals and gives practical pointers on operating methods that help avoid trouble

► SLAG FORMATION in first-pass tubes and sometimes in the superheater often proves troublesome in pulverized-fuel-fired boilers operated at high rating. Boiler and furnace design has developed to such a degree that slag troubles may usually be traced directly to operation and only on rare occasions to burner design or application.

To adhere to tubes, slag must enter the first pass in a plastic or molten state. This happens only when temperature is above ash-fusion point or a reducing atmosphere surrounds ash particles, lowering their fusion point. Insufficient excess air, high-rating operation, or combustion of gas or solids as they enter the first pass may cause high temperature.

Although fuel may be well pulverized in the accepted sense it is, nevertheless, a solid and not a gas and must burn accordingly. At 2400-F furnace temperature, the cube of air required to burn a given cube of coal has a side approximately 50 times as great. It is true that volatile matter distills off immediately, but coke remains as a solid. A certain amount of molecular activity and air movement eventually burns the coke, but for suspension burning, time is short and to insure complete combustion turbulence is needed at combustion temperatures.

Obtaining Turbulence

Turbulence results from reversing flame direction, impinging flames against each other, causing secondary air to strike the burning mass, or any other method of making coke particles slide through an oxidizing atmosphere at combustion temperatures. If necessary intimate contact is not achieved promptly, burning coke enters first pass and higher temperatures result.

Occasionally, in an attempt to boost efficiency, operators reduce excess air below the ratio for which the furnace was designed. This may cause first-pass temperatures above ash-fusion point, and slagging. This condition is easily recognized and corrected.

The CO_2 recorder or steam-flow air-flow meter may indicate proper fuel-air ratio at boiler outlet, but air infiltration between first-pass entrance and boiler outlet may conceal the fact that a definite air shortage exists in the furnace. Taking simultaneous samples at furnace and boiler outlets gives a good check on this point. If difference in CO_2 readings exceeds 1%, setting should receive attention.

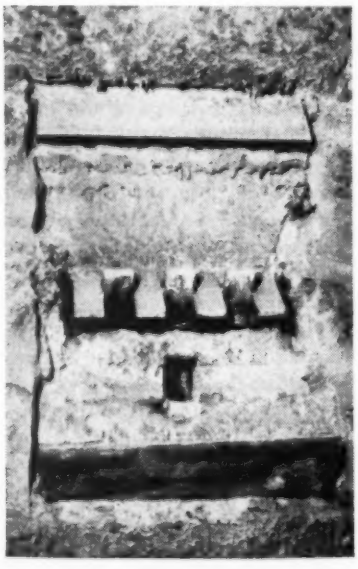
In some plants equipped with steam-flow air-flow meters, operators insist on following every ripple of the steam-flow pen. However, many boilers have ample storage capacity to handle small load swings and sensitive feedwater regulators help by momentarily retarding feed when load increases and opening up when load drops off. As a result, pressure does not change materially and although meter pens may be apart, combustion conditions in the furnace remain substantially correct.

Under such conditions, over-ambitious operators try to pull the two pens together by manual operation of secondary-air control and the fuel-air ratio goes off, depending on which way air is changed. If air is increased, a loss results, and if it is decreased, a shortage exists, producing possible slagging and a loss from unconsumed carbon in flue gas.

To keep out of trouble, it is essential that fuel and air enter the furnace in proper proportions at all times. Coal delivery from some mills is controlled by feeder speed or opening, while on others it depends on amount of air put through the pulverizer. If delivery depends on feeder speed or opening, a definite lag exists between feed increase, grinding and delivery. Most controls take care of this situation by retarding secondary air a corresponding amount. This can be checked by taking flue-gas analyses as fast as possible over a period of time. If delivery depends on primary air, no lag is permissible. Air starts sweeping coal out of the mill, or leaving it in the mill, depending on whether demand increases or decreases, as fast as the control opens, and secondary air must stay right with fuel control.

It proves possible for instruments to indicate proper fuel-air ratio and a

BURNER DESIGN AFFECTS TURBULENCE



In burner designed for post-ignition turbulence, about 30% primary air enters with fuel, at high velocity, through burner located midway between secondary-air inlets. Crisscross water-cooled prongs tear solid stream into thin sheets. Secondary-air openings have wide watercooled prongs that spread and deflect air streams into fuel streams. Adjustable prongs permit varying impact angle between flame and secondary air, usually 90 deg. At higher ratings, if velocity is too great with 30% primary air, additional air enters around burner. This air mixes at burner tip and is, in effect, primary air, as it is in contact with fuel before ignition occurs. If burner is used through a water-cooled wall, minor construction changes are required

BEFORE AND AFTER PHOTOS SHOW BAD CASE OF BOILER SLAGGING

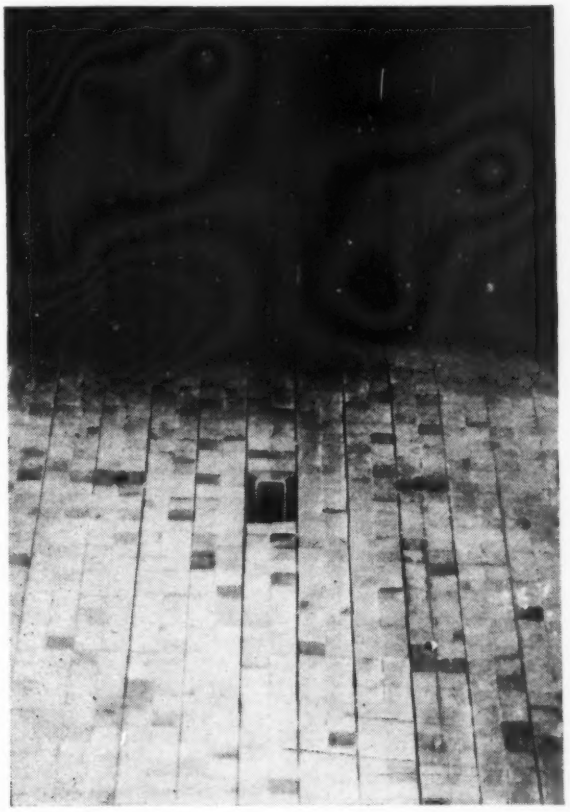


Photo at left shows watercooled refractory wall before unit began operation while photo at right shows same spot three months later, after a bad 24 hours. Slag trouble started immediately after boiler foreman sharpened gradient on master control. Secondary-air control was slow and set up a perfect hunting condition. Fortunately, forced-draft-fan controlled furnace draft and pressure in furnace did no harm to ironwork. While load was steady at 325% rating, CO_2 varied from 9 to 16% at 8-min intervals and steam pressure and exit temperature kept step with CO_2. Furnace was laid out for 350% with a good margin of safety and this condition lasted about four hours. Then hunting stopped but boiler output fell off and CO_2 varied, depending on position of fuel control. As pressure went down, old boilers picked up plant load and at the end of 18 hours boiler rating had dropped to 75%. The forced-draft fan had slowed down to a walk and all agreed that something was wrong. Fuel was reduced enough to clear the stack and at the end of 24 hours, the boiler went off the line. While the photo shows honeycomb slag, there is hard slag behind it, well fastened to the tubes

check to show a tight setting even though slag forms. Inspection shows streaks of flame of more or less intensity entering the first pass. Poor distribution of fuel usually causes this. It may be unequal distribution in individual burners, some burners getting more or less than their share, or both. Burner layouts are usually made with the idea of having each carry its share and while it may prove possible to increase or decrease secondary air to individual burners it is better and safer to have each burner do its part so that furnace is evenly loaded. Poor distribution to individual burners is usually taken care of by mixers in the burners. If burner is not so equipped, mixer must be installed in the fuel pipe as it enters the burner.

If two or more boilers connect to a common header, feed to one may be increased while being retarded to another. Although boiler pressure and load may remain constant, individual boiler rating may increase or decrease depending on feed rate. This separates steam and air pens and if secondary air is changed manually to bring pens together, fuel-air ratio in both boilers will be wrong. If boiler operating with insufficient air works near maximum capacity, slag may begin to form in first pass. It is simply a matter of a few minutes until the situation reverses and the same condition exists in the second boiler.

Although pulverized-fuel-fired boilers are responsive, it is possible and not uncommon to set control gradient too wide for the installation to keep in step. A hunting condition occurs and control overtravels on both ends. The fact that furnace is underloaded part of the time does not mean that slag deposited during overload periods will disappear. Such a condition does not show on a CO_2 recorder, but if fuel and air are synchronized, fluctuations will be revealed by the air pen on a steam-flow air-flow meter. Narrowing the gradient corrects this condition unless it results from a slow-starting control and must be attacked from that end.

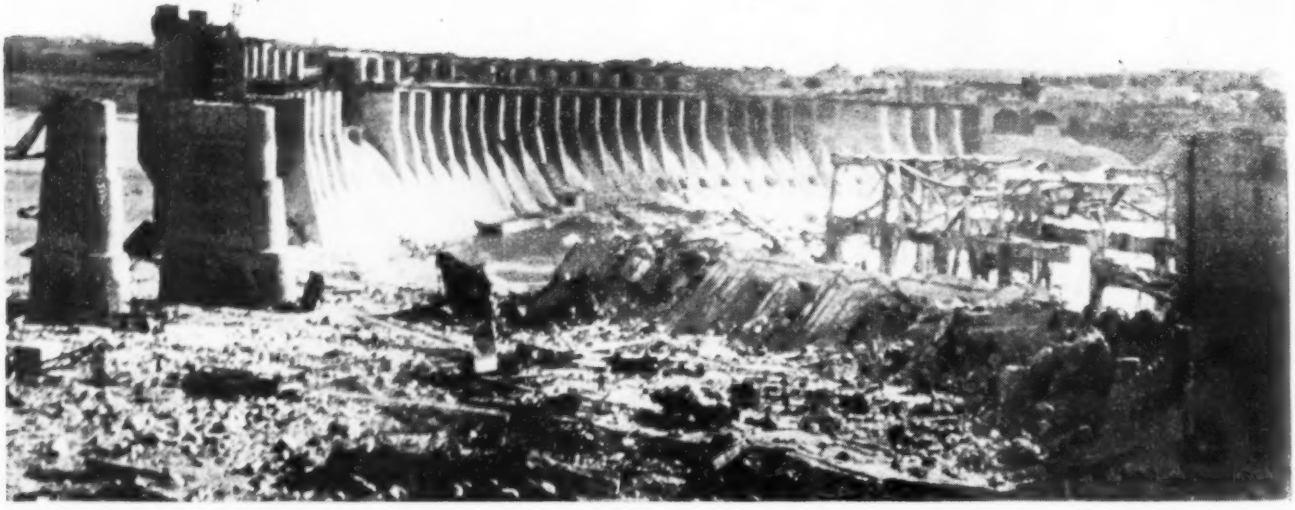
Possibly the installation carries an extremely variable load and average load is near guaranteed performance. This means that furnace conditions during heavy pulls will exceed design conditions. While it may not prove

practical to hold a steady steam pressure, it will help to set control gradient very steep and at the same time set upper stops on the master to prevent furnace overloading and lower stop just low enough to prevent popping.

Under these conditions, if slagging continues it may prove necessary to resort to periods of hand operation and the instant the load increases add fuel to maximum furnace capacity, hoping it will be enough to hold pressure within operating limits. There is no use in exceeding capacity for any length of time as the furnace will release just so much heat. The same operation will apply when installation becomes overloaded because of some unexpected demand. Fire the furnace to maximum capacity and, if necessary, back off only to prevent popping.

If, for some reason or another, it becomes necessary to burn fuel with a lower ash-fusion point than that for which the unit was designed, the above tactics will have to be used unless it is possible to operate at lower rating. If rating must be held at maximum, about all that can be done is to use excess air available and at the same time hold furnace conditions as steady as possible, keeping steam pressure within operating limits.

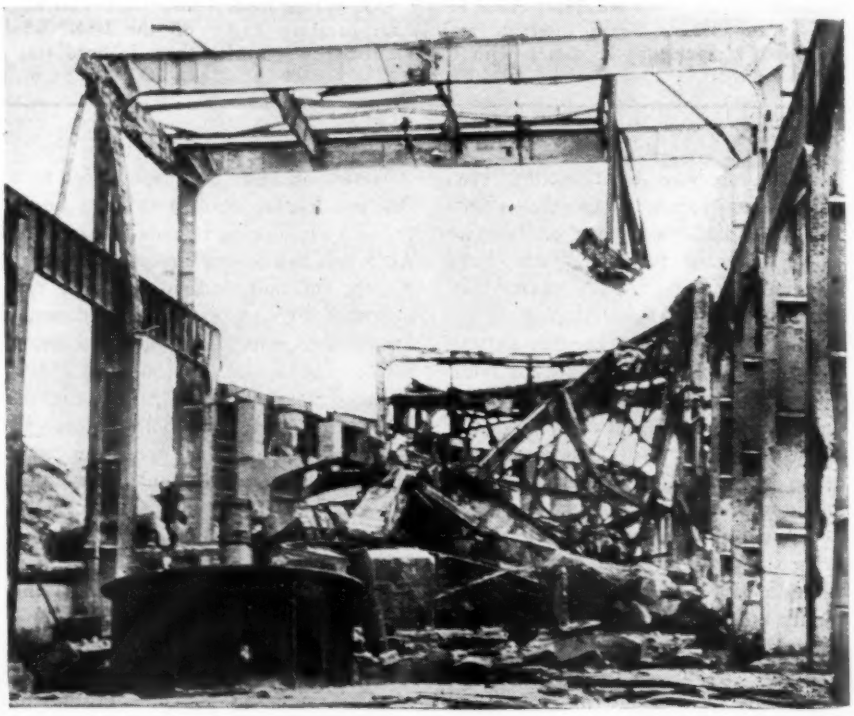
Dnieprostroy Dam to Rise from Ruins



Press Association, Inc

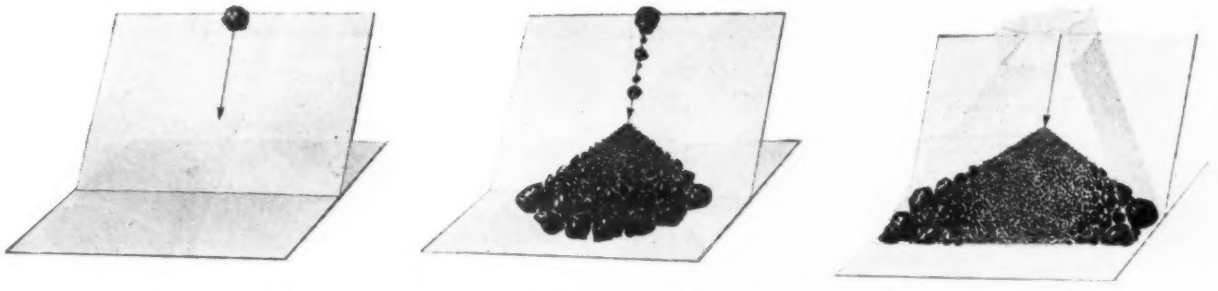
▶ INSIDE OF 18 MONTHS, the Dnieprostroy dam and powerhouse will be back in operation after having been destroyed in August, 1941, during the German advance into the Ukraine. Newport News Shipbuilding & Drydock Co is now rebuilding the turbines and General Electric the generators. These pictures come from a series made by Maj Gen Philip B Fleming, Federal Works Administrator, while on a Presidential assignment to study Soviet reconstruction.

One of the world's largest, this hydroelectric project was designed by the late Hugh L Cooper, well-known American consulting engineer. Construction began in 1927 and the plant went into operation in 1933. Its nine 84,000-hp turbines, designed for 116.5-ft head, drove 77,500-kva 0.8-pf generators; under maximum head of 123 ft, the turbines could develop over 100,000 hp. Dam had a maximum height of 200 ft and a spillway 2500 ft long in center for a maximum river flow of 835,000 cfs.

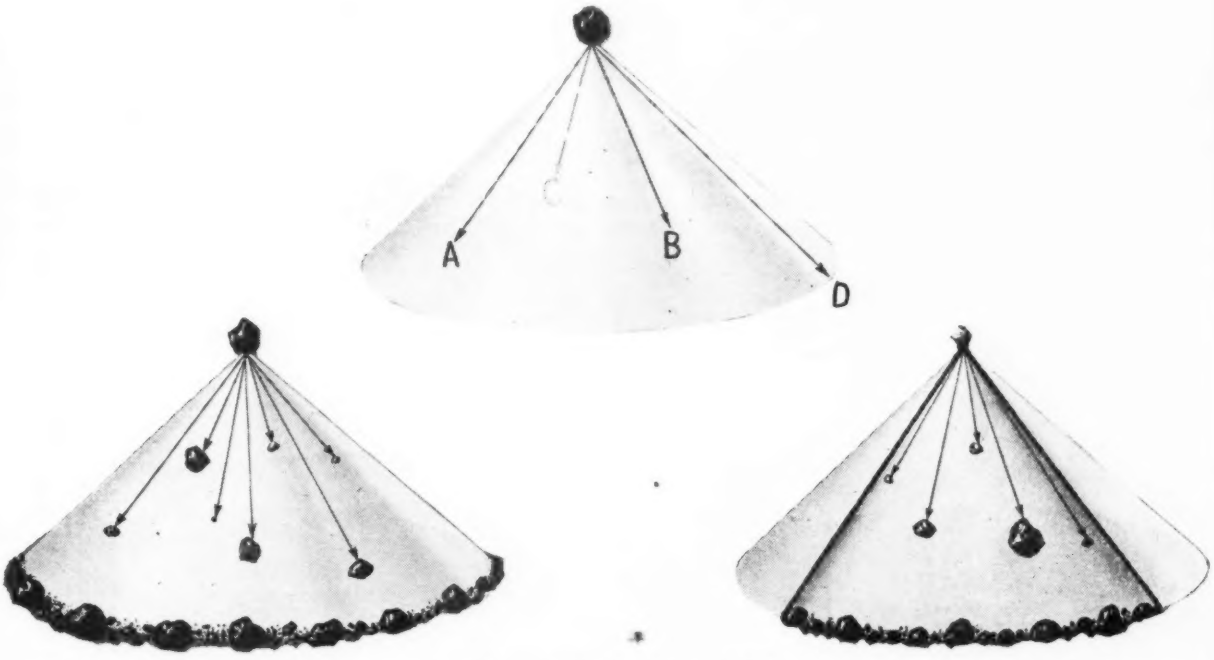


Coal Segregation in Boiler Plants

With no attempt to follow the original in detail, this is the essence of the paper presented by Arthur J Stock at the June, 1944, Pittsburgh meeting of the ASME



If a mixture of fine and coarse coal is fed down an inclined flat plate or a flat chute, the fine coal tends to stay near the center. The coarse coal tends to roll over the fine to the outer edges



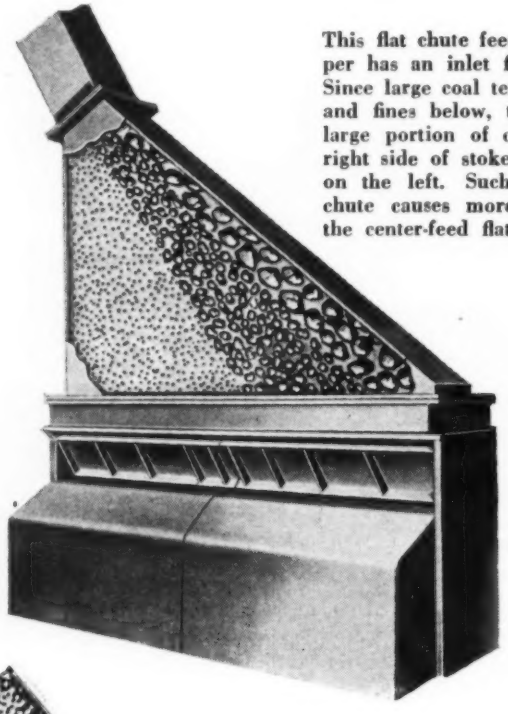
If coal is fed at apex of a cone with vertical axis, one straight-line path down is as easy and direct as another. Therefore, fine and coarse coal tend to distribute themselves equally along all elements of cone. Under-surface of a chute can have this conical form to prevent segregation

► COAL SEGREGATION in boiler plants limits steam output, increases maintenance and wastes fuel. It hinders stoker operation because coarse coal acts differently from fine. Resistance of the fuel bed to air flow varies with the coal size. Coarse coal burns faster and lets excess air through the fire. Fine coal, on the other hand, may reach the ashpit only partly burned.

Furnace maintenance is increased by coal segregation. Unequal distribution of temperature along the furnace walls, and variations in gas velocity, damage the refractories.

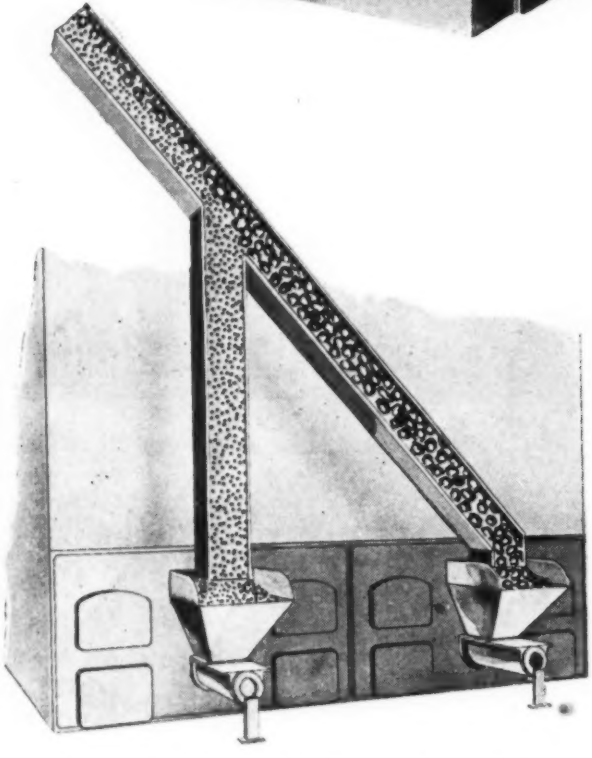
With pulverized coal, segregation in the chute is immaterial, but bunker segregation that changes coal size from minute to minute causes corresponding variations in the grinding capacity of the mill.

Any proper study of segregation in a given plant must survey every step from car to inside of furnace because segre-

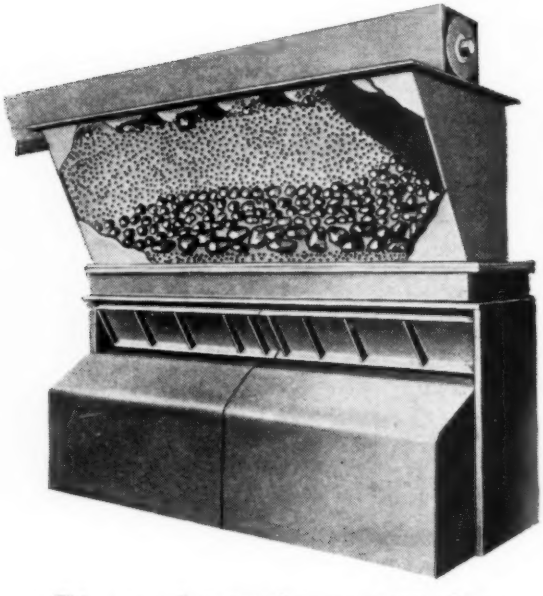


This flat chute feeding a stoker hopper has an inlet flange on left side. Since large coal tends to flow on top and fines below, this design puts a large portion of coarse coal on the right side of stoker and of fine coal on the left. Such an eccentric flat chute causes more segregation than the center-feed flat chute

When coal slides through a sloping down-spout the coarse coal gradually rises to top of the spout, while fine coal sinks to the bottom



When a single chute branches as shown, the fine coal in the bottom of the single chute will go chiefly to the left-hand branch



This type of segregation can occur where a screw conveyor, installed along top of the stoker hopper, operates only now and then

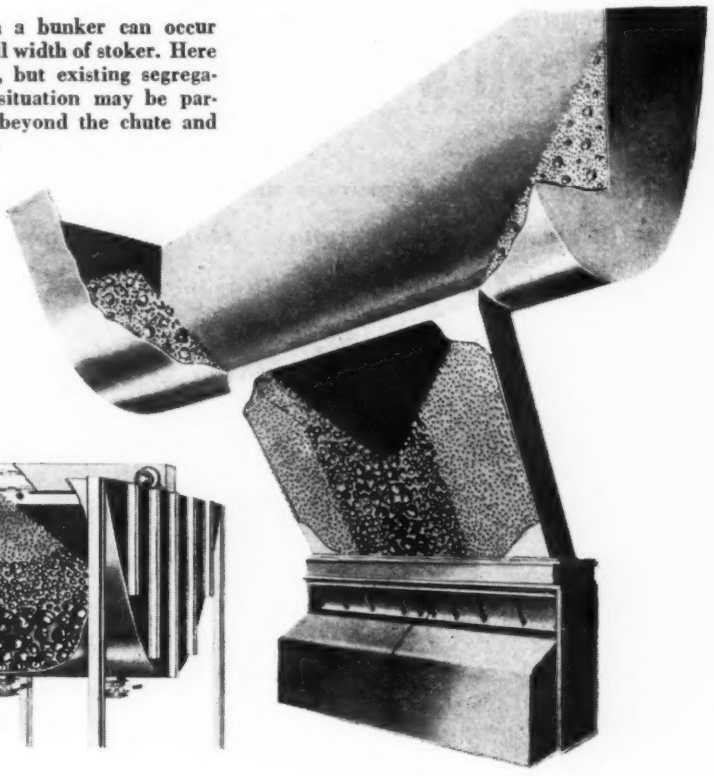
gation causes in the early steps often cannot be corrected further along in the process. Hence the very great importance of "nipping segregation in the bud," so to speak.

Segregation is more often caused by equipment than by poor operating methods. The sketches show many of the ways in which equipment, primarily, can separate fine coal from coarse, with bad effects on capacity, efficiency and maintenance.

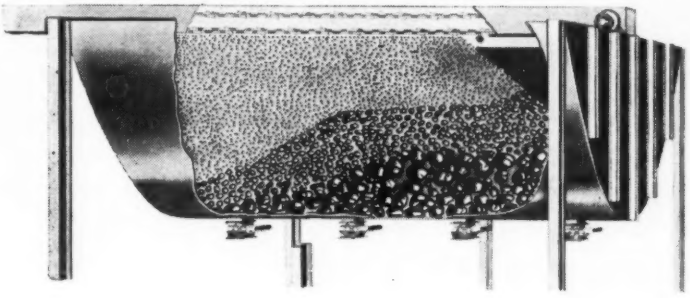
While this presentation is concerned primarily with coal segregation, it is important to note two other types—air segregation and moisture segregation. The former is usually caused by poor design of the plenum chamber or air ducts. Note, however, that the uneven distribution of fine and coarse coal is often the basic cause of uneven air flow through the fire.

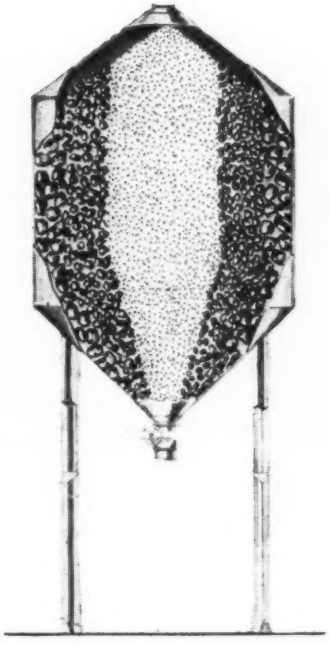
Moisture segregation, too, may be mistaken for coal segregation, or *vice*

Segregation with a flat chute leading from a bunker can occur even where the length of the chute is the full width of stoker. Here segregation does not originate in the chute, but existing segregation in the bunker is not corrected. The situation may be particularly serious where the bunker extends beyond the chute and the bunker is nearly empty, as shown here



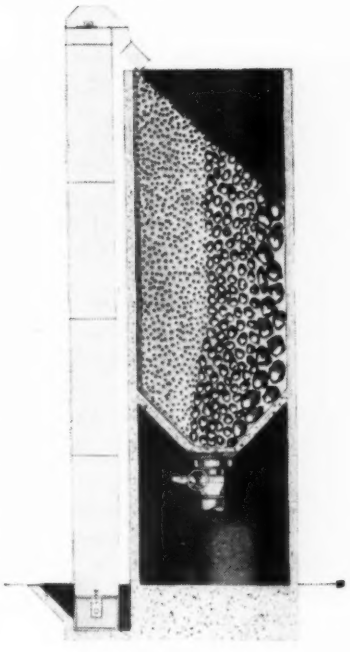
This shows one way in which coal can become segregated in a bunker. Here the bunker is fed by a flight conveyor without a trough. Conveyor fills the left end first. A pile is formed, the top of which moves toward the unfilled end. This method puts the coarse coal on the right side and the fines on the left





Left: **In the case of the steel silo with a vertical center feed, the fine coal collects in the center with the coarse distributed around the periphery. When the coal is withdrawn from such a silo, the fine coal comes out first, followed by a mixture which progressively becomes coarser**

Right: **In the concrete silo fine coal accumulates on the side near the elevator, with coarse material predominating on the opposite side. As coal is withdrawn this segregation continues. If coal from such a bunker is fed to a stoker hopper with its long dimension parallel to the plane of the illustration, coarse coal will appear mainly on the right side of the stoker hopper and the fine on the left. If the plane of stoker or silo can be turned 90 deg, segregation will be less**



versa. Here the test is the fact that the latter gives a definite pattern, whereas the former usually produces a variable pattern. Most cases of moisture segregation result from irregular tempering of coal by steam in the stoker hopper. If coal is to be tempered by steam, this should be done in the down spout ahead of the distributor, or else the coal should be tempered with water as it enters the bunker.

Best time to eliminate segregation is when the boiler room is still in the design stage. The illustrations show points to check. Well considered design will insure a plant that operates properly. It is just as important to check proposed coal handling facilities for coal segregation as to check the drawings for dimensional accuracy.

Coal segregation in existing plants may be reduced or eliminated by proper operation of equipment as installed, or by revising that equipment.

Power Development Forms Keystone Of Peru's Plans for Industrial Growth

Rich in mineral resources and potential hydroelectric power, Peru hopes to build an industrial economy. Under government direction, proposals for the integrated development of the Santa River valley now receive consideration

By CHARLES A HOWARD
Technical Director, Inter-American Development Commission

► DEVELOPMENT of large hydroelectric potentialities constitutes the keystone of Peru's extensive plans for building an industrial economy founded on abundant mineral resources. Work has already begun on the 125,000-kw Canyon del Pato project on the Santa River, some 250 miles north of Lima.

Important as this power plant is to the future industries of Peru, it is only a part of the larger development program, which envisions:

(1) Full development of the power potential of the Santa River, Peru's largest west-coast stream.

(2) Development of anthracite reserves in the Santa valley estimated at 10,000,000 tons.

(3) Consideration of steel-plant construction close to the port of Chimbote near the Santa's mouth.

(4) An irrigation project to bring water to 250,000 desert acres and, at a later date, a cement mill and other industries to use this power in refining magnesium and other minerals said to exist in commercial deposits in this region.

Recently, these projects have been brought together under the Corporacion Peruana del Santa, headed by David Dasso, formerly Minister of Finance and Commerce and well-known in American engineering circles. Peruvian estimates put the cost of the entire development program at about $30,000,000. An Export-Import Bank credit of $25,000,000 has been set up in favor of the Banco Central of Peru to assist in financing purchases in the United States of materials and equipment required for these industrial, mining and agricultural projects.

The Department of Ancash, where this regional development program centers, is one of the most beautiful sections of Peru and has been called the Switzerland of South America. Here the Andes rise in two great parallel ranges, the Cordillera Negra to the west, with peaks over 14,000 ft, and the Cordillera Blanca, or White Mountains, to the east, whose snowcapped heights of over 20,000 ft give the range its name. These snow fields not only represent a prime tourist attraction but also are said to provide the Santa River with a reasonably constant year-round flow.

Santa River Valley

The valley between these two ranges (see map), about 75 miles long, 20 miles wide and averaging about 9000 ft above sea level, is called the Callejon de Huaylas. It is an important mineral and agricultural area and has a delightful climate. The Santa River rises in the south, flows northward down this valley, turns westward in a great arc and finally cuts its way through the coastal range, forming a canyon nearly eight miles long and several thousand feet deep. Here, in a distance of five and a half miles, the river drops about 1400 ft.

Located at the head of this canyon, the dam for the Santa River power plant stands nearly 6000 ft above sea level. It is 80 ft high and 130 ft wide at the top. Dam and tailrace are specially reinforced to resist erosion of sand and gravel swept down by floods. A 5.5-mile 18-ft diversion tunnel will carry water, at a calculated rate of 39 cubic meters per sec, to the generating station farther down the canyon. Plans call for eventual installation of five 25,000-kva units, two of which are expected to be installed by the end of 1945.

The nature of the installation is such that power cost is expected to be low. Barton M Jones, a former Tennessee Valley Authority engineer, is advising on this project, assisted by Andrew T Komara, an irrigation engineer, also from TVA.

As a part of the main project, the 86-mile railroad which now runs from the port of Chimbote to Huallanca, a point near the Canyon del Pato site, is to be extended and electrified. Hand labor is being used where possible to minimize the need for hard-to-get imported machinery. Some 1200 men are employed.

Peru's plan for industrial development includes what may become one of the major projects of the Americas, that of bringing water to 250,000 semi-arid acres on the Pacific slope of the Andes and a little to the north of the Santa River. This task will require eight to ten years. The agricultural region to be created is intended to feed the new industrial city expected to rise in the vicinity of Chimbote Bay following development of coal mines, power sites and other heavy industries.

If plans to irrigate are carried out, about 100,000 kw of additional power might be developed by taking advantage of the drop of 4500 ft between the Santa River hydroelectric plant and the sea. Charles W Sutton, an irrigation engineer from the United States, is advising on this project.

Industrial development in the Santa River area will require shipping facilities. Chimbote Bay, 250 miles north of Callao and 1300 miles south of Panama, is about seven miles long, four miles wide and from 24 to 60 ft deep. It is rated as one of the finest natural harbors on the west coast of South America, which possesses few good harbors.

In April, 1942, construction began on a modern pier at Chimbote which,

when completed, is to be more than 3000 ft long and to have all the latest appliances for handling heavy cargo and loading steamers with coal.

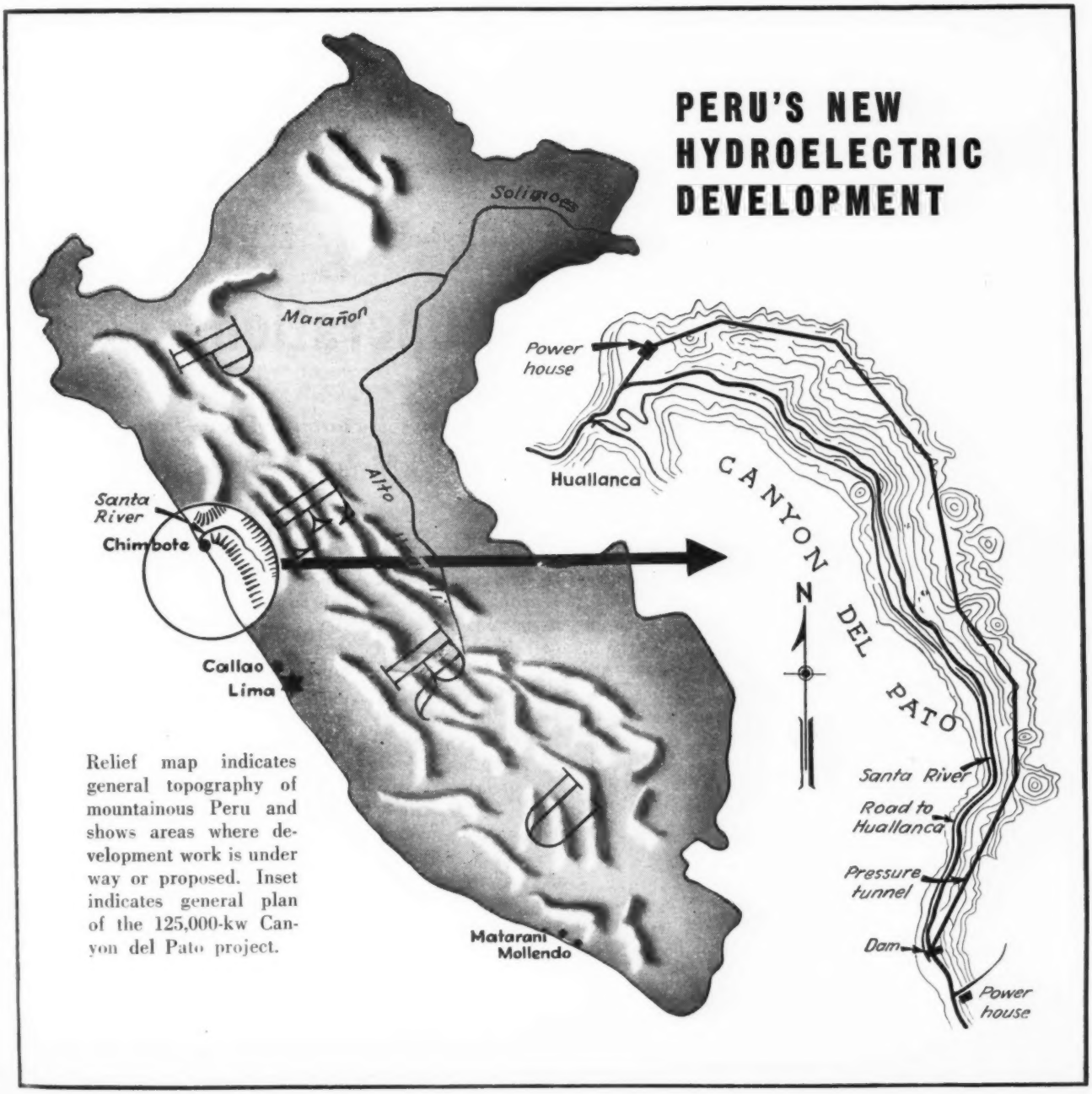
Coal for coastwise and foreign shipment will come from Santa and Chuquicara valleys. These deposits, 68 miles inland from Chimbote, have veins ranging from three to nine feet in thickness. This Chimbote anthracite is already being mined on a small scale; in Dec, 1943, 9000 tons were shipped to Peru, Uruguay and Argentina.

When the port works at Chimbote are finished, Peru will have three fine ports on the Pacific. Callao, port of the city of Lima, has been converted in recent years, at a cost of over $10,000,000, into one of the best-equipped dock areas on the west coast. An outlay of $3,700,000 has likewise turned the bay of Matarani, in southern Peru, into a modern port in every respect. Matarani is nine miles north of Mollendo, which is not a port at all but only an open roadstead where handling of freight and passengers by launches and barges is not only costly but often hazardous. Matarani, with a wharf 1476 ft long, has ample docking facilities for large steamers.

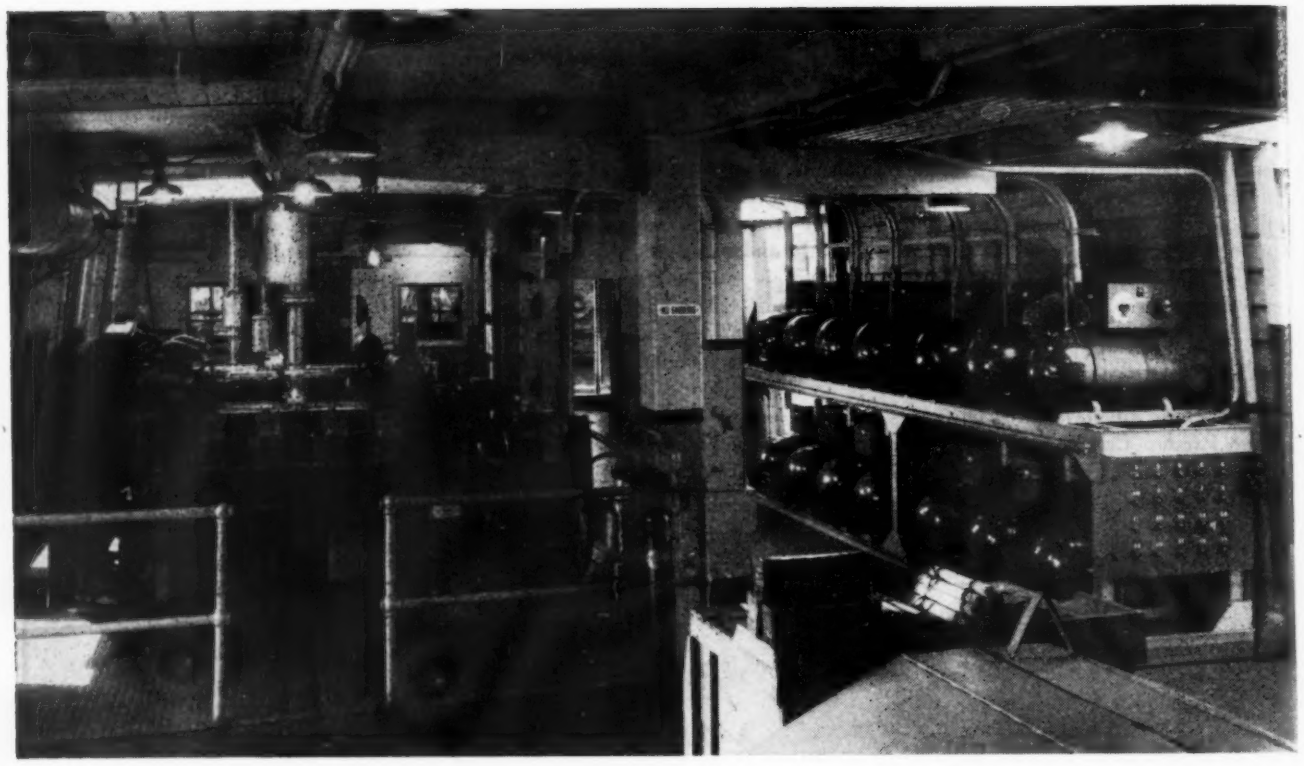
In order to give Peru's southern empire access to this fine harbor and an outlet to world markets, there must still be built some 39 miles of railroad to connect Matarani with the main line of the Southern Railways of Peru, now running from Mollendo to Arequipa. A shorter railway will connect Matarani directly with Mollendo. Wartime shortages of materials and shipping have delayed completion of these two rail connections.

Some idea of the importance placed on power as an element in building up the national economy can be gained by noting that the Canyon del Pato project alone will add more capacity than the national total of 1938, when 210 plants of all types boasted an installed capacity of 102,176 kw. By 1941, this number had increased to 592 plants with a capacity of 219,746 kw. Of

(*Continued on page* 162)



Relief map indicates general topography of mountainous Peru and shows areas where development work is under way or proposed. Inset indicates general plan of the 125,000-kw Canyon del Pato project.



Diesel-Powered Welding Barge Speeds Shipyard Operations

Brought alongside any water site or dock, this self-contained and highly efficient unit saves valuable space in crowded yards and cuts fire hazard

▶ CARRYING its own diesel-power supply, a recently built, self-contained, electric-welding barge can be floated alongside any water site or dock for new construction or arc-welding repair. Not only does it conserve space in crowded shipyards, but it increases fire safety by its ability to leave a pier in an emergency, and by using diesel oil instead of volatile gasoline.

Built and owned by Master Welding Service of New York, this unique unit now serves reconversion and repair welding work for the U. S. Navy and the Maritime Commission at the Todd Hoboken Shipyards, Hoboken, N. J. Here it replaces many of the more conventional "space-grabbing" individual gasoline- or diesel-engine-driven electric welders usually seen along busy docks.

The barge, of wood construction, is 80 ft long and 30 ft wide with 5 ft draft. Height above water line is 14 ft.

A 200-kw diesel plant supplies power for 30 standard 300-amp welders and lighting. The two main units are 8-cyl 5¾ x 8-in. 900-rpm 135-hp Caterpillar V-type engines, direct connected to 85-kw 220-v 3-phase 60-cycle self-regulating Allis generators rated at 300 amp, continuous. For lighting and auxiliary power there are two 4-cyl 3¾x5-in. 1500-rpm 25-hp Caterpillar diesels driving 15-kw 220-v 3-phase 60-cycle Electric Machinery Mfg Co generators.

Engines are radiator cooled, supplied from two 1000-gal fresh-water makeup tanks below decks. Also below decks are four 2500-gal fuel-oil and two 1080-gal lubricating-oil tanks. A 100-gal fuel-oil day tank mounts overhead on the top deck. In design of power plant and auxiliary equipment, self-sufficiency was stressed, to permit operation away from a supply base for as long as 60 to 90 days at a stretch.

A 500-lb Kidde CO_2 system provides fire protection for the entire barge. Oil-storage tanks below decks are inclosed in two fireproof steel compartments each equipped with a continuous pipe loop and nozzles. Compartment piping is sectionalized and remotely controlled from main deck. The system also supplies a centrally located reel with snow horn and 75 ft of hose.

As the photo above shows, the engine room occupies a central position, with a construction office and cabin, which includes sleeping and eating quarters, at one end. Welding generators stand along one side of the barge, in three 2-level banks of 6, 14 and 10 units respectively, working forward from the stern or construction cabin end. Individual generators are type SAE-300 Lincoln 220-v 3-phase 60-cycle units with a full-load current of 58 amp. Welders are banked for ground-bus con-

nection, five machines to a bus, 2000-amp capacity per bus.

Welding cable is stored on reels, about 500 ft to each. Reels mount on racks at the forward end. Cables carry electrode holders at one end; the other end plugs into work outlets like those at the end of the welding-generator bank in the photo on the facing page. Near the cable racks are storage bunkers, welding-electrode-stub containers and an electrode-distribution table with scales for weighing electrodes out and stubs in.

In operation, number of welding arcs in use determines whether one or two of the main generator units runs. Welding machines have their own start-stop buttons, and are protected by individual integral thermostats. Each unit also includes low-voltage and no-voltage protection. The engineer adjusts the welding heat or current for each arc by self-indicating current dials on each machine. Regulation in steps of five amp or less is obtainable. Voltage of each machine can be adjusted individually, as desired.

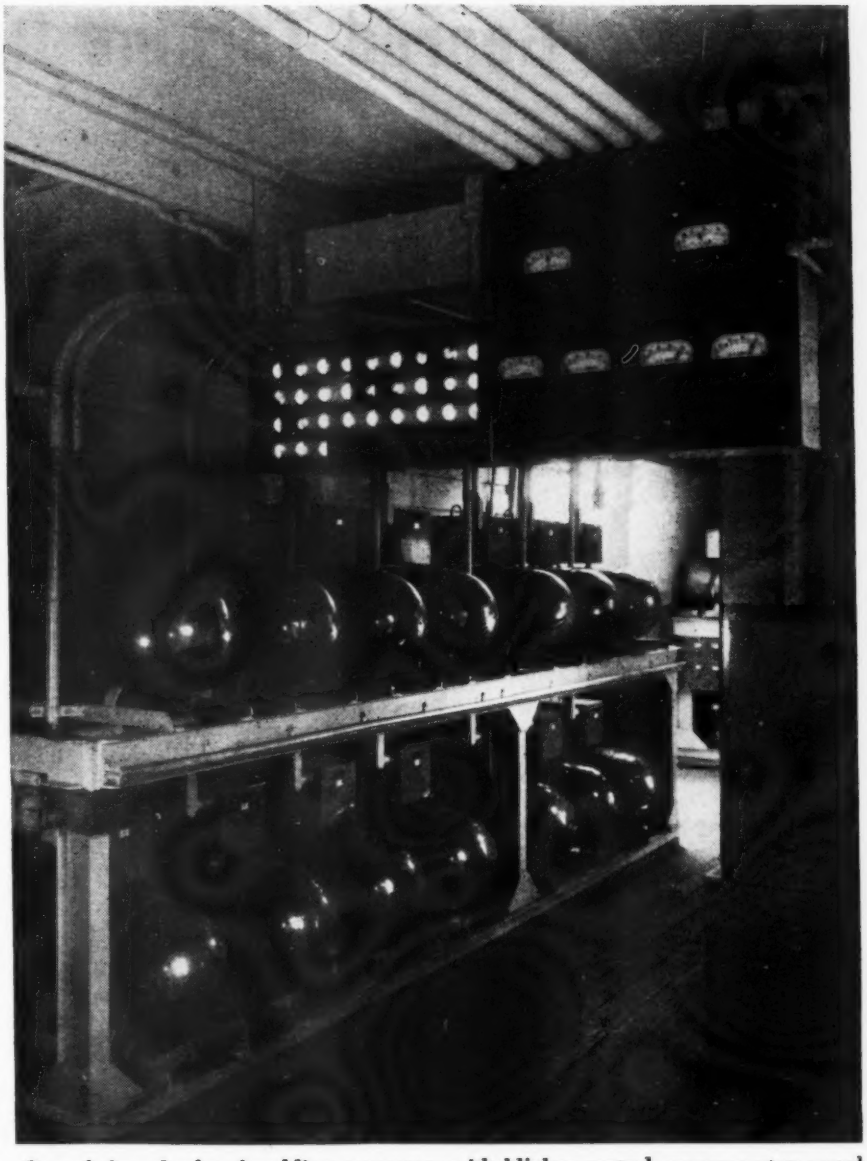
Indicating Panel

A panel visible from the construction office carries master ammeters indicating total current of the two main generators, and voltmeters also. A blinker panel alongside the meter board (see photo) shows number of machines operating and number welding. A bright light indicates a unit that is operating but not welding, and a dim light indicates welding. Blinker panel also gives a clear indication of the work factor of each welding operator, thus giving management a valuable check on actual welding time.

Actual operating costs depend on a large number of variable factors. However, the following computed costs reveal some interesting points. On a basis of 4800 gal of No. 2 diesel oil per month at 10¢ per gal and 480 hr per month, fuel consumption averages to 10 gal per hr. This gives a fuel cost of $1.00 per hr for 30 welding machines or 3.3¢ per machine per hr.

Figuring 96 gal of lubricating oil per month at 60¢ per gal gives a total of $5760 per month, or 12¢ per hr. For 30 welding arcs this works out to 0.4¢ per hr per machine. Total cost of fuel and lubrication thus comes to 3.7¢ per hr per welding machine.

Barge installation was designed for Master Welding Service, Joseph Babosky, president, by Charles E Dell, Consolidated Edison Co of N. Y., a former marine engineer and welding consultant of wide experience.



One of three banks of welding generators with blinker control, upper center, panel carrying ammeters and voltmeters, upper right, and cutout switch, lower right

Welding barge at work in typical location, Todd Hoboken Shipyards, Hoboken, N. J.

Geared Turbine Rides the Rails

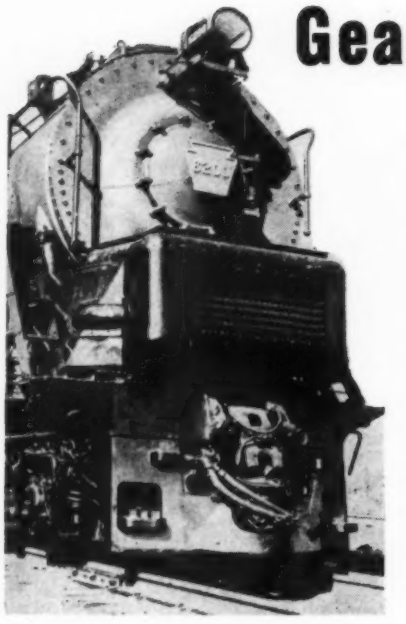


Photo above shows head end of new locomotive, with air-swept oil cooler

Below: Main, or forward, turbine is housed in the casing shown below the boiler, between second and third pairs of drivers. A smaller turbine, located on left side and brought into operation by a clutch, moves the engine backward

► READY FOR heavy main-line passenger and freight service at speeds up to 100 miles per hour, this new turbine-powered Pennsylvania Railroad locomotive has successfully completed first test-track trials. Product of Baldwin Locomotive Works and Westinghouse, the locomotive represents first application to rail service of turbine drive through double-reduction gears.

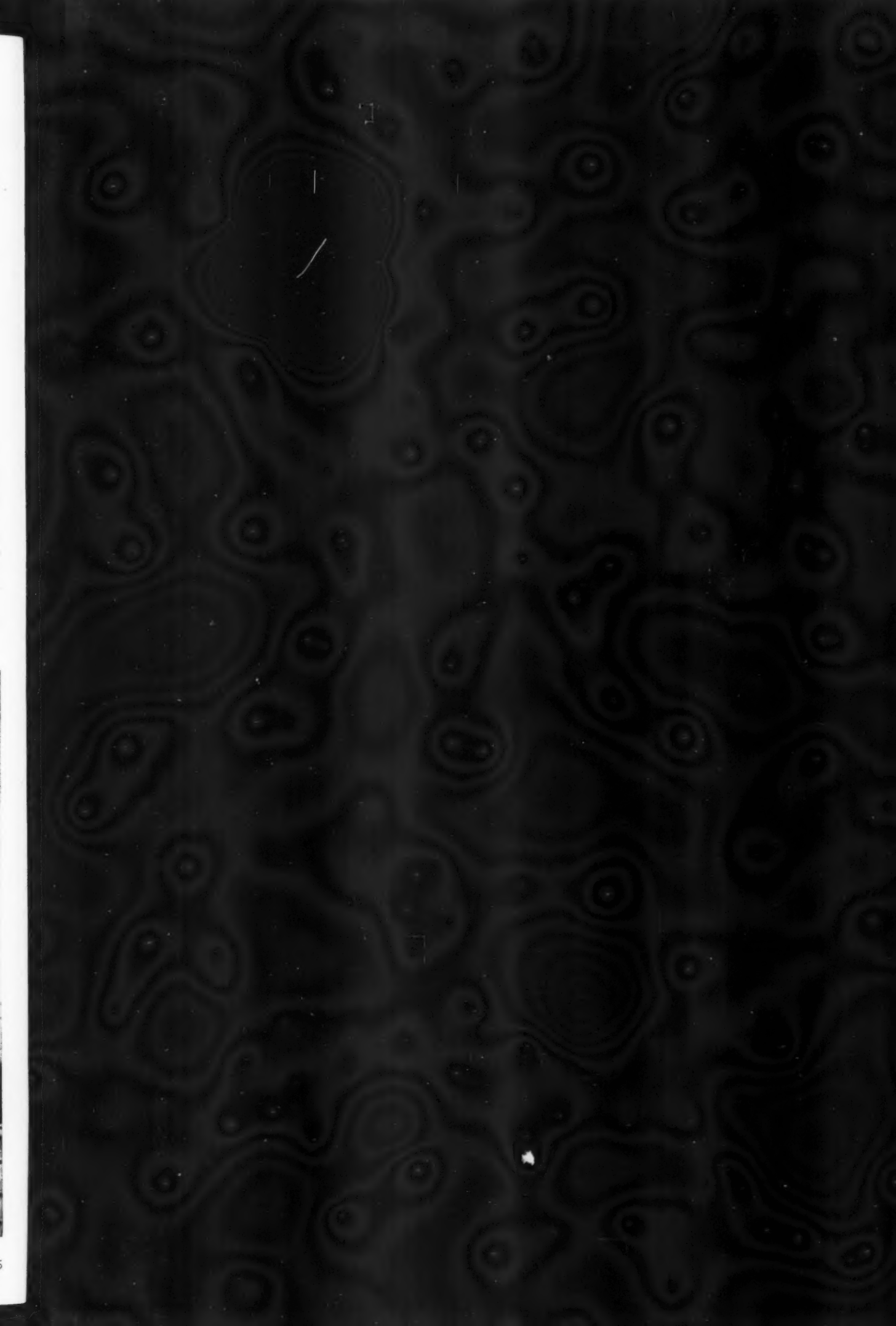
Engine and tender weigh nearly a million pounds and cover 123 ft of track. Boiler is a standard type delivering steam to the turbine at 310 psi and 750 F, quite ordinary conditions for modern locomotives. Turbine and drive mechanism, however, are radically different from anything now on rails in this country.

Turbine design follows experience gained in ship drive. The 6-stage prime mover is set above the second and third drivers of the four pairs of driving wheels. Up to 6900 hp is delivered to two axles through a double-reduction gear. For reversing, a separate single-stage turbine on the left-hand side just opposite the main turbine is connected to the head pinion through a clutch.

Extensive main-line trials and dynamometer tests will check the expected improvement in efficiency over reciprocating-engine performance, about a fifth more power for the same steam. This represents not only a fuel saving, but, even more important to the railroad, greater power from a locomotive of given dimensions.

While cab, boiler, tender and wheel arrangement are quite conventional, cylinders, external valve gear and main rods are missing, and with them the inherent unbalanced forces of the reciprocating engine that cause pounding at high speeds. Absence of vibration is one of the important objectives of the design.

Main turbine can be seen inclosed in a casing below the boiler but above the main drive wheels. Smaller reversing turbine occupies a similar position on the opposite side of the locomotive and is not visible in the photo.



Hydroelectric Power: Mainspring of Canada's Industrial Development

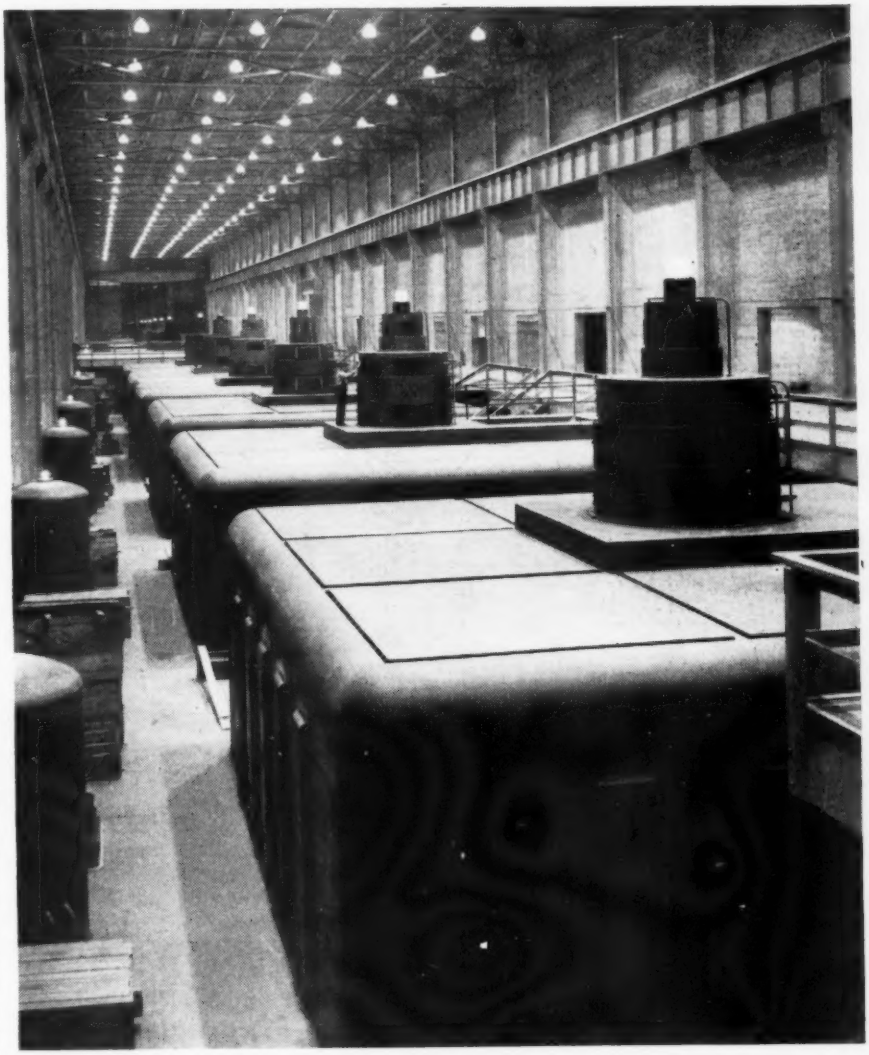
Canada is developing her tremendous waterpower to compensate for lack of fuel. With her central stations in 1943 generating 99% of 40 billion kwhr in hydroelectric plants, she has become one of the world's most highly industrialized nations

▶ WITH ONLY 11,500,000 population—about half of one percent of world's total—Canada stands third in world imports and exports, and second in the British Empire in manufacturing. Fourth producer of United Nations' war supplies, she is topped only by the U. S., Russia and England. Mainspring of all this is her great waterpower.

Potential waterpower, which will require over 50,000,000-hp turbine capacity, totals 40,000,000 hp, ordinarily available six months of the year. About 50% is in highly industrialized Ontario and Quebec, with no commercial coal and little oil and natural gas. Here Canada has 85% of her 10,214,000 hp of hydro turbines, of which central stations have over 9,000,000 hp and industrials about 1,000,000. In 1943 central stations generated 40,000,000,000 kwhr, of which hydroelectric plants produced nearly 99%.

Because of the vast number of lakes, tremendous wooded tracts and other factors, rivers average higher flow than almost anywhere else. Most notable is the Great Lakes system, regulating flow into Niagara and St. Lawrence Rivers to close limits. Of 5,000,000 hp that can be developed on the St. Lawrence, Canada's share is 4,000,000. Saguenay River rises in Lake St. John, with 410 sq mi area at high water, which provides 4,000,000 acre-ft storage down to low-water level. On rivers flowing into this lake, 6,000,000 acre-ft additional storage have been developed. Other rivers, notable for large storage to regulate flow, include St. Maurice, Ottawa, Gatineau, Nipigon, Winnipeg and Nelson.

Lack of low-cost fuel has influenced industrial hydro development: Of particular interest is installation of electric steam boilers to use power which has no immediate market. Industrial plants have enough such capacity for 1,500,000 kw, with single boilers requiring over 40,000 kw.

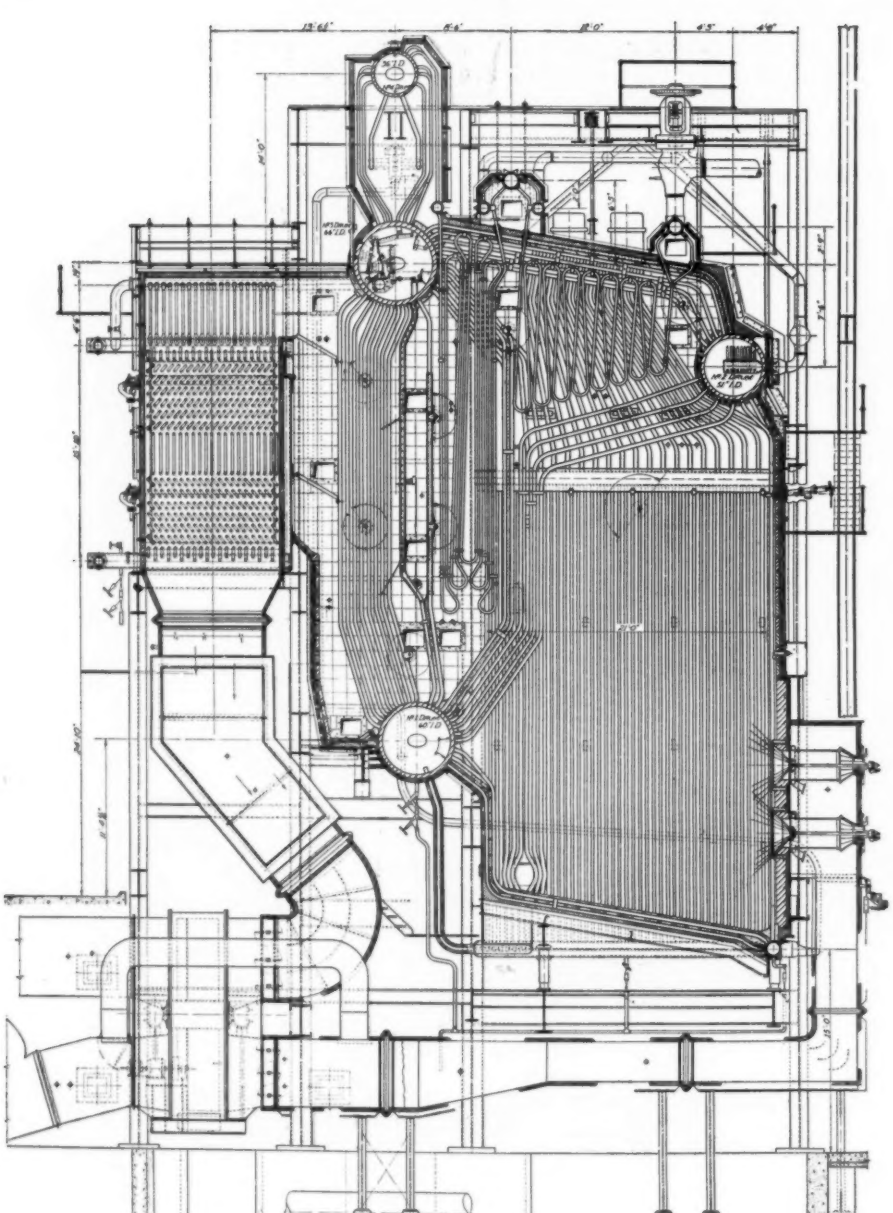


With eight 100,000-hp and four 85,000-hp units, Aluminum Co of Canada's Shipshaw No. 2 plant on the Saguenay River is the largest single concentration of power in the world. Its sister plant, Shipshaw No. 1, sometimes called Chute-a-Caron, with four 75,000-hp units, operates from the same forebay but with a 160-ft head

In 1941, of nearly 8.5 billion kwhr purchased by the pulp and paper industry, 3.5 billion were for steam making. In 1943, paper-mill electric-steam-making power was only about half that in 1941, war production absorbing the difference. Thus, Canada has built her industries with waterpower as their mainspring until now her central stations produce and her industries consume more than twice the power per capita (3480 kwhr) that the United States generates (1630 kwhr).

(*Continued on page* 98)

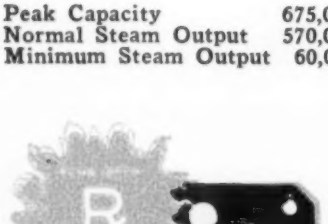
Results from this RILEY Unit on



Complete RILEY STEAM GENERATING UNITS consisting of Riley Boilers, Superheaters, Economizers, Water-cooled Furnaces, Steel-clad Insulated Settings and Air Heaters, fired by oil and gas.

GUARANTEED PERFORMANCE

Peak Capacity	675,000 lbs./hr.	Efficiency	86.1%	Steam Temperature	915°F.
Normal Steam Output	570,000 lbs./hr.		at 570,000 lbs./hr.	Furnace Width	36'0"
Minimum Steam Output	60,000 lbs./hr.	Steam Pressure	1050 lbs.	Furnace Depth	21'0"



RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

It will pay you to visit modern Riley Installations

Pacific Coast are truly outstanding

Results when operating at 538,924 lbs./hr.

87.8% Efficiency

PRESSURES AND TEMPERATURES

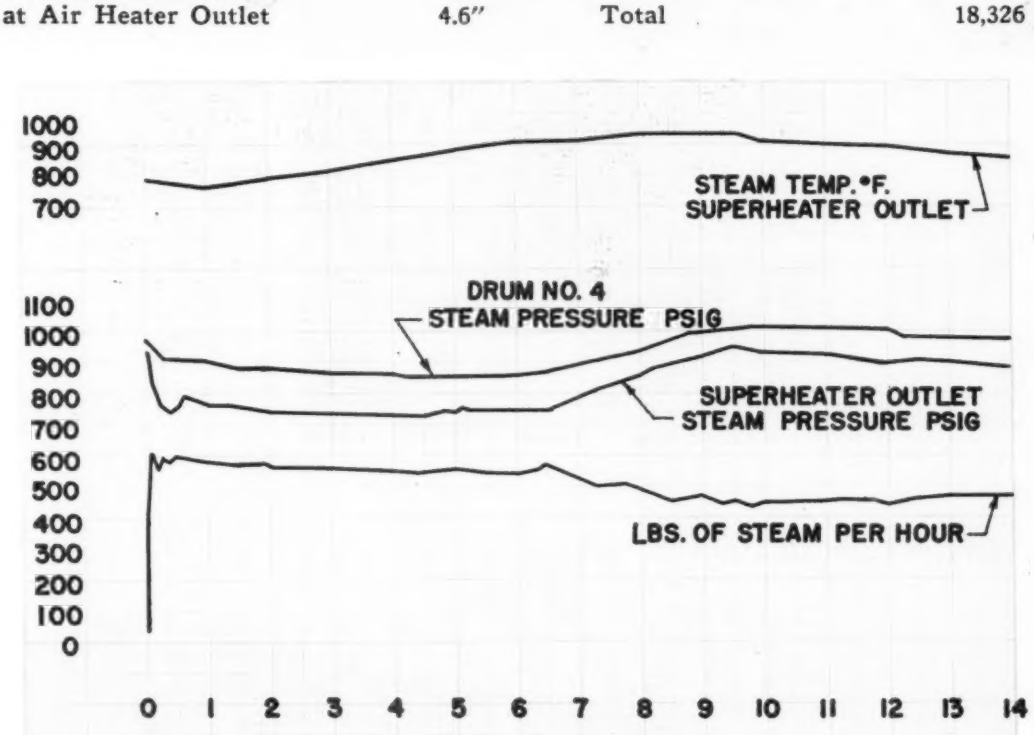
Steam Pressure, Boiler Drum	1044 lbs.
Steam Pressure, Superheater Outlet	1001 lbs.
Temp. Water Entering Economizer	406°F.
Temp. Water Entering Boiler	456°F.
Temp. Gases Leaving Boiler	770°F.
Temp. Gases Leaving Economizer	610°F.
Temp. Gases Leaving Air Heater	295°F.
Temp. Air Entering Air Heater	72°F.
Temp. Air Leaving Air Heater	442°F.
Air Pressure Entering Air Heater	5.8"
Air Pressure at Burners	4.0"
Draft in Furnace	0.1"
Draft at Boiler Outlet	1.9"
Draft at Economizer Outlet	2.6"
Draft at Air Heater Outlet	4.6"

HOURLY QUANTITIES

Actual Steam Flow	538,924 lbs.
Weight of Fuel Fired	35,954 lbs.
B.T.U./lbs. of Oil	18,326 B.T.U.
B.T.U. Heat Release	29,250 B.T.U.

HEAT BALANCE

Heat Absorbed by Unit	16,090	87.8
Loss Moisture in Fuel	1	0.0
Loss Hydrogen in Fuel	1097	6.0
Loss Moisture in Air	7	0.1
Dry Gas Loss	883	4.8
CO	0	0.0
Combustible in Refuse	0	0.0
Radiation and Unaccounted for	248	1.3
Total	18,326	100%



QUICK LOAD PICK-UP TEST

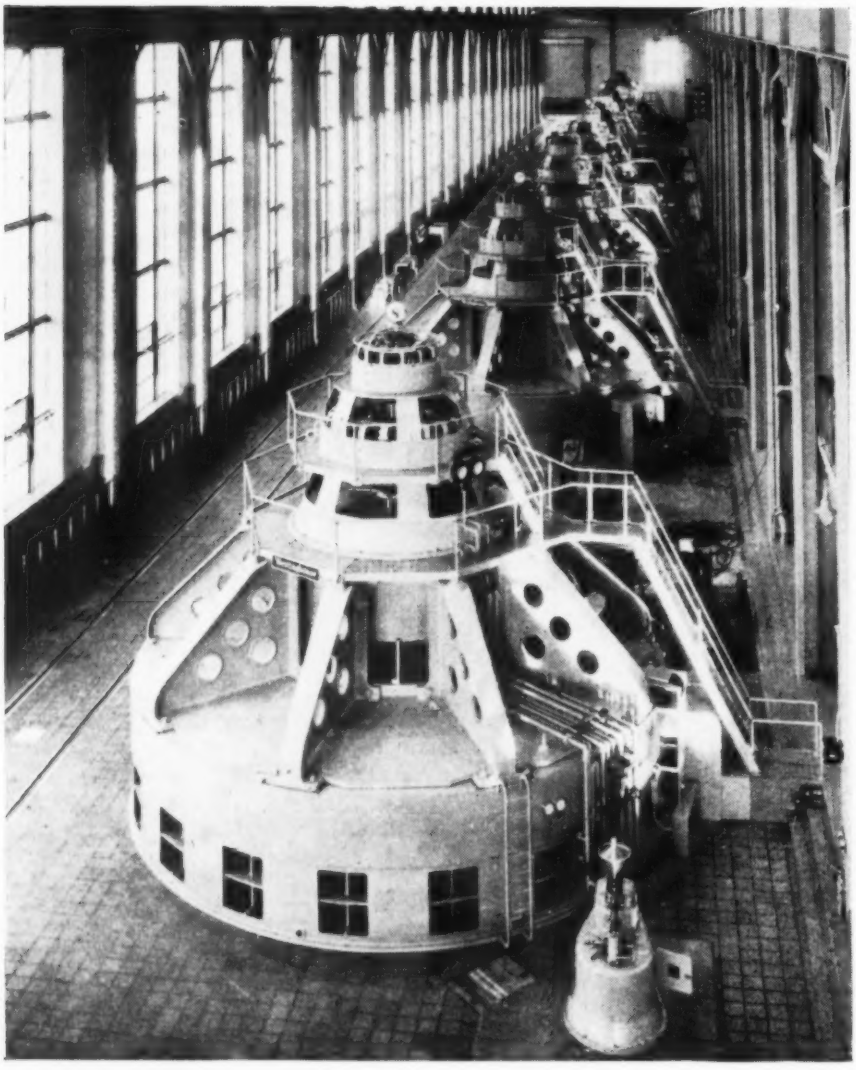
This unit at times operates as stand-by to hydro-power requiring almost instantaneous pick-up in load. When operating on stand-by service, the unit idles along at 60,000 lbs. of steam per hour. When the load comes on, steam output must increase to over 500,000 lbs. of steam per hour in seconds. The above curves show such performance with a load jump up to 600,000 lbs. of steam per hour in less than 10 seconds and stabilized operation at high ratings in a few minutes.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

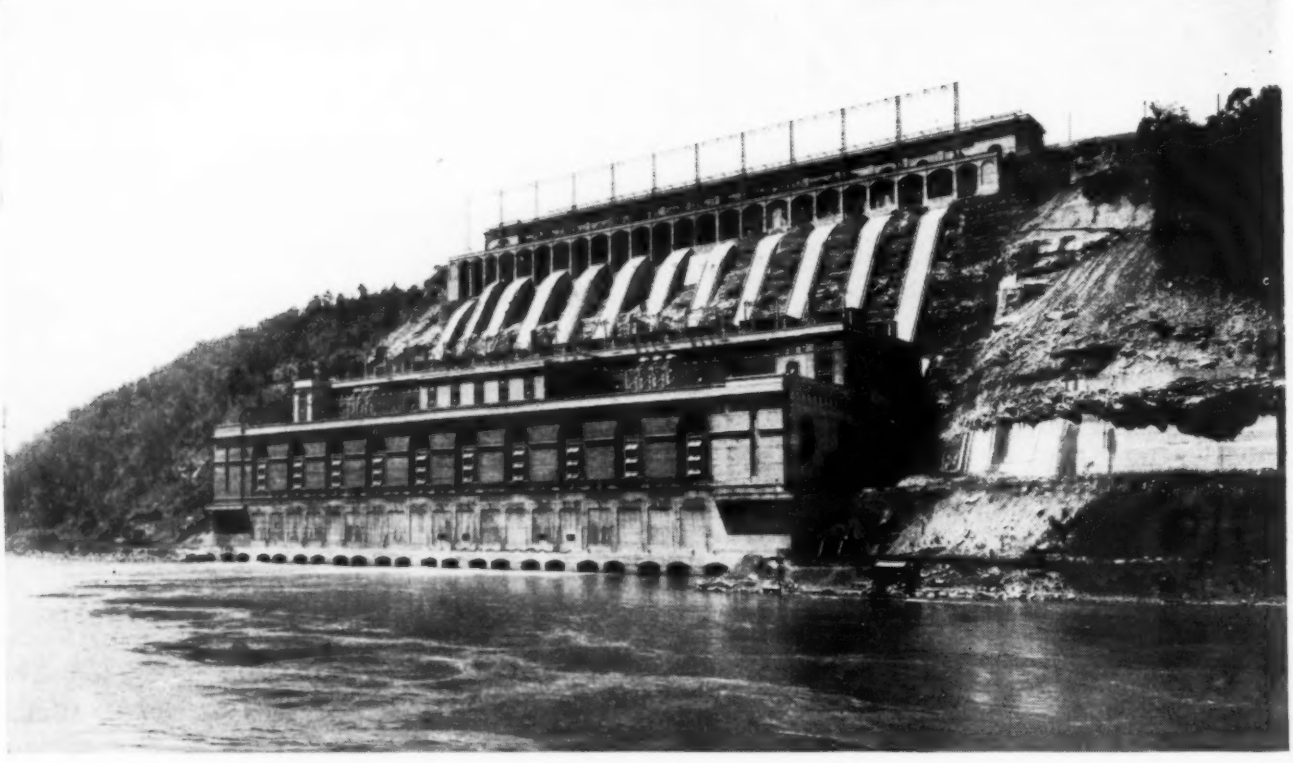
before purchasing Boiler or Fuel Burning Equipment



On the Ottawa River, one of Canada's great sources of waterpower, the Chat Falls plant, 35 miles above Ottawa astride the Ontario-Quebec boundary, develops 224,000 hp in eight 28,000-hp units. This plant was built and is owned jointly by the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Co. The Commission operates the plant and purchases the Ottawa Power Co's half of the power. Its generators are driven by fixed-blade propeller turbines, operating under 52-ft head

La Gabelle plant, of the Shawinigan Water & Power Co, on the St. Maurice River, has five fixed-blade propeller turbines, with a total capacity of 172,000 hp, operating under a 65-ft head

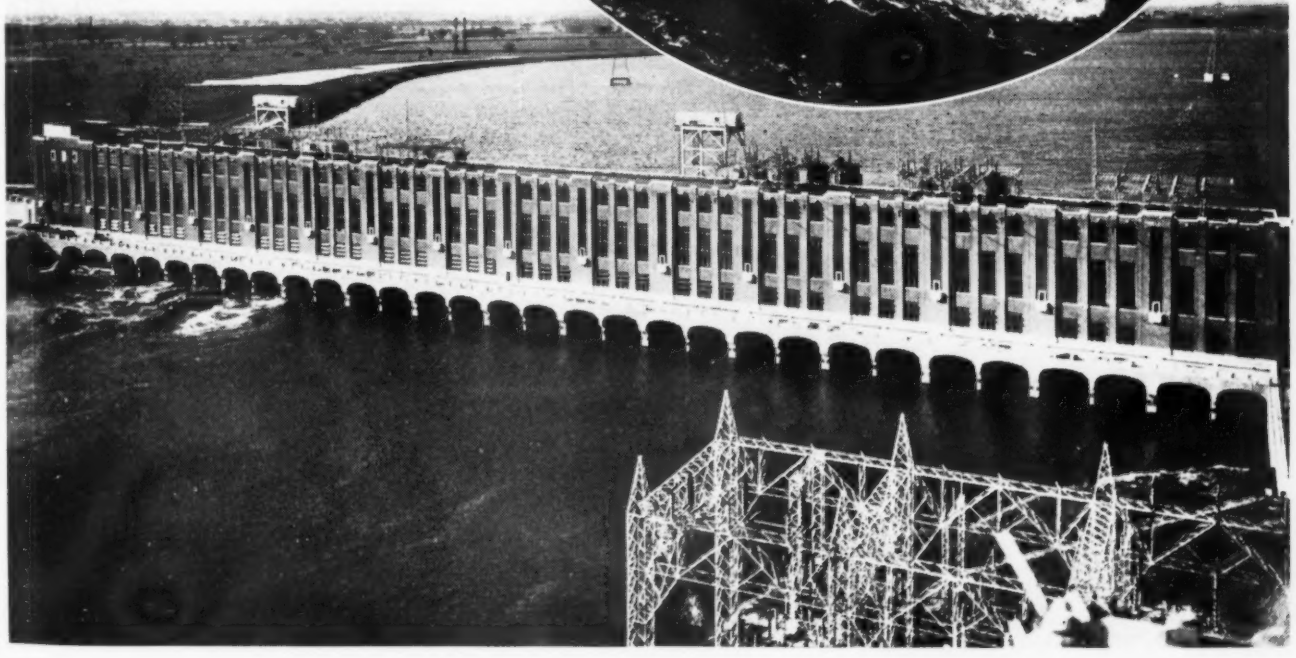
Queenston-Chippewa power development of the Hydro-Electric Power Commission of Ontario uses 305 ft of the total 327 ft fall in the Niagara River between Lakes Erie and Ontario. Water is brought in a 13-mile-long canal from four miles above the falls to near Lake Ontario, and conducted by penstocks down over the escarpment to generate 560,000 hp in ten main and two service units under a 294-ft head. Construction work on this plant started in 1917; the first unit began operation during 1922 and the plant was completed in 1930



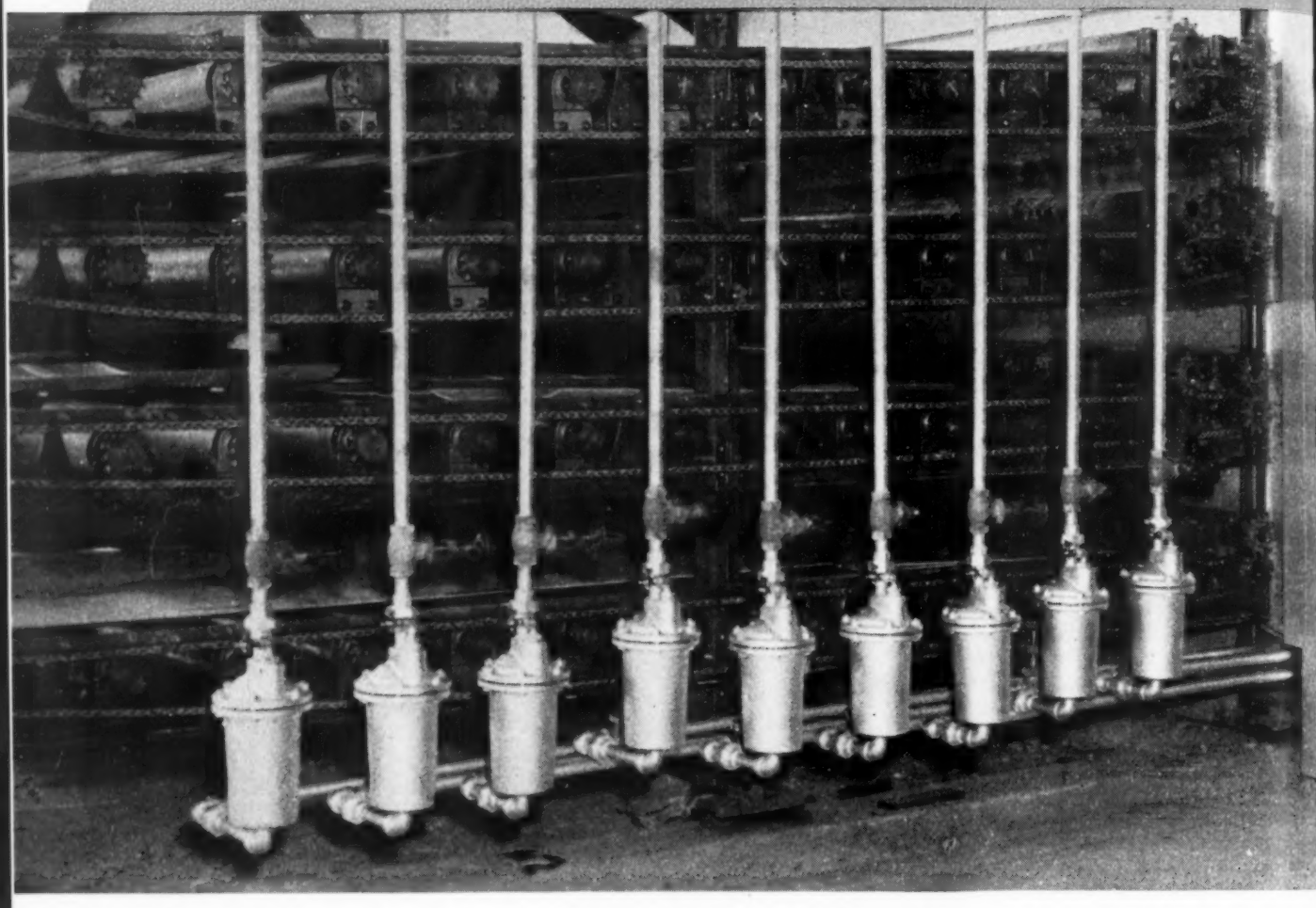
Isle Maligne plant of the Saguenay Power Co is one of Canada's largest, with 540,000 hp installed in twelve 45,000-hp units operating under a 110-ft head. This plant forms the dam across the grand discharge from Lake St. John, which provides about 4,000,000-acre-ft of usable water-storage capacity. ⟶

Beauharnois development, on the St. Lawrence River near Montreal, of the Quebec Hydro-Electric Commission, was designed for forty 53,000-hp units. This plant uses, through a canal, the 82-ft head between Lake St. Francis and Lake St. Louis, and now has installed over 700,000 hp in thirteen 53,000-hp main and two 8000-hp service units

(*Continued on page* 102)



"ENOUGH COAL FOR 3000 YEARS



How Important *Are* Steam Traps? *Read These Records of Coal Savings*

LAUNDRY CUTS FUEL COSTS 35% — Peerless Laundries, Ltd., Los Angeles, one of the world's largest laundries, reduced heating-up time by 30 minutes, reduced maintenance costs 8% by installing Armstrong Traps.

27% FUEL SAVING AT HOTEL — Mount Washington Hotel, Bretton Woods, N. H., experienced 27% reduction in fuel consumption the first year after Armstrong Traps were installed.

CUTS COAL BILL $650 ANNUALLY — A Huntingburg, Ind., firm spent $417 for Amrstrong Traps and saved $650 on coal the first year they were installed.

STORE EQUIPMENT CONCERN SAVES 170 TONS COAL — At the Northwestern Store Equipment Corp., Milwaukee, Wis., Armstrong Traps save 170 tons of coal per year; heating-up time on wood drying kilns cut from 5½ hours to 2½ hours, and back pressure on steam engine used to drive line shafting dropped from 7 - 10 lbs. to 2 lbs.

GREENHOUSE SAVES $1067 ON COAL IN ONE YEAR by using Armstrong Traps. This unit trap installation saved 220 tons of coal per year.

HIGH SCHOOL CUTS COAL CONSUMPTION 50% — The Springfield City High School, Springfield, Ohio, reduced coal consumption from 8-9 tons per day to 4, by installing 30 Armstrong Traps.

TRAPPING SAVES MUNICIPALITY $2600 A YEAR — Oil City, Pa. saved exactly $2651.42 in fuel the first year Armstrong Traps were installed at the city water pumping station.

PLYWOOD COMPANY SAVES CAR-LOAD OF COAL PER WEEK — Atlas Plywood Corp. of Canada Ltd., Waterloo, Quebec, effected this saving by installing Armstrong Traps. Believe it or not this company has effected a 100% savings on coal purchases, since the coal was supplementary to a waste wood supply.

ARMSTRONG SAVES CANVAS GOODS MANUFACTURER 50% FUEL COSTS — Couch Bros. Mfg. Co., East Point, Ga., used only 4½ tons coal for heating purposes instead of 9, after installing Armstrong Traps.

ARMSTRONG *Inverted Bucket*

. . may not do you any good today!

conserve it with ARMSTRONG STEAM TRAPS

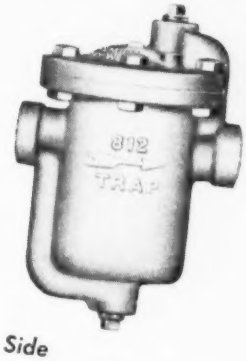
**A recent estimate of bituminous coal deposits in the United States indicated that there is enough for another 3000 years, but it's the coal in your bin that counts today.*

Armstrong Traps save coal because they don't leak steam . . . because they discharge condensate as rapidly as it accumulates . . . because they automatically vent air—thereby allowing the steam to give up its heat where it is supposed to for productive results.

Armstrong Steam Traps are available for all services and all pressures. Sold by leading distributors and jobbers everywhere. Guaranteed to satisfy. Over a million in use. Write for 36-page STEAM TRAP BOOK.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Michigan

Bottom inlet Top outlet



Side inlet — Side outlet

FEATURES:

1. Stainless Steel bucket and lever system.
2. Chrome steel valve and seat — hardened, ground and lapped.
3. Frictionless leverage system.
4. Swirling action of condensate cleans out all ordinary dirt and scale.
5. Choice of body styles.
6. Automatic air elimination.
7. Every trap factory tested.

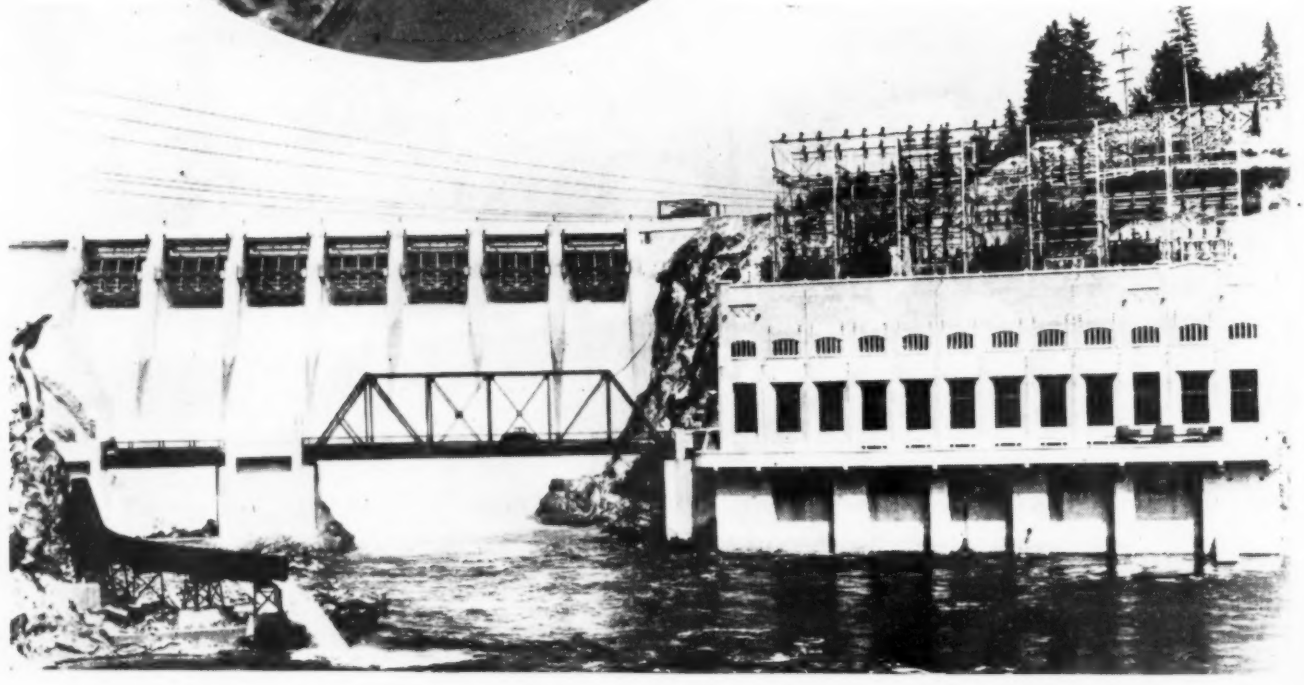
ARMSTRONG · INVERTED BUCKET · STEAM TRAP

STEAM TRAPS *for* **POWER PROCESS HEATING**

On the Winnipeg River, which flows from Lake-of-the-Woods to Lake Winnipeg, Great Falls plant of the Winnipeg Electric Co has 168,000-hp capacity in six 28,000-hp units operating under a 56-ft head. When the initial units were installed, they operated under the highest head and were the largest fixed-blade propeller turbines in the world

Cameron Falls plant, of the Hydro-Electric Power Commission of Ontario on the Nipigon River in western Ontario, has an installed capacity of 75,000 hp under a 72-ft head.

British Columbia, with 11,000,000-hp potential waterpower, has developed 800,000, of which the British Columbia Power Corp's Ruskin plant is a part. This 94,000-hp plant on the Stave River, 40 miles east of Vancouver, has two 47,000-hp units operating under a 125-ft head, with space for two more.



WHAT DOES AMERICA WANT?

IT IS THE PURPOSE of this editorial, the thirty-first of a series, to state the urgent need for a clear declaration of American policy in world affairs.

Within the past few weeks there has been a wakening conviction in this country that the determination of international arrangements cannot safely be put aside until victory has been won. For we have seen actions taken in Europe seemingly without full consultation and agreement of the Allied powers, which may profoundly affect the design of the post-war world.

A declaration of American policy is needed, and it should be accompanied by a statement of our firm intention to exert full effort to procure its acceptance and furtherance. Emphatically, this does not mean that an American platform should be put forth as an ultimatum, which other nations must accept totally, or reject at the cost of having the United States withdraw from collaborative participation in world agreements and organization. On the contrary, the first plank in such an American platform should be a firm commitment on our part to participate with our associate nations in building a general system of world security and order. By definition, this requires that each participant be willing to accommodate its purely national interests to a program that can be accepted as fairly representing the interests of all. But equally, there is imposed on each participant an obligation to state honestly and openly what it conceives its individual interest to be, as well as its concept of what measures will best serve the general interest.

☆ ☆ ☆

Americans have displayed a singular diffidence in the matter of formulating a bill of American objectives—singular, in that it contrasts so sharply with our power to exercise as broad a leadership as we are able to define. This reluctance stems partly from the inherent difficulty of arriving at a coherent statement of national aims in a country like the United States—so vast in area, so multiple in its sectional and group interests, and so soundly committed to the free expression of individual thought. But it stems also, in part, from a tradition of national isolation which, however understandable in historic perspective, now stands clearly discredited by two world wars which were not of our making, but from which we were unable to hold aloof.

That the economic wellbeing and political security of the rest of the world is closely bound to the decision and performance of the United States is questioned nowhere but in America. Political boundaries and restrictions cannot build effective fences against the interplay of economic forces, and the sheer weight of American economic influence is of crucial import to all the other nations of this globe. In large measure their decisions will be shaped either in response to the opportunities that our procedures offer them, or in defense of interests that our procedures may jeopardize.

☆ ☆ ☆

The United States contains only about 6 percent of the world's population. But—our national income, before the war, amounted to almost 25 percent of world income; our industrial output as a whole approximates 45 percent of world totals, and we now are producing a like percentage of the world's munitions; we have 35 percent of the world's railroad mileage; 25 percent of merchant fleet tonnage; 50 percent of the world's telephones; 45 percent of steel production; 40 percent of aluminum production; 33 percent of coal output; we are refining (though part of the production comes from imports) 55 percent of the world's copper, and 70 percent of its petroleum; we now are producing 50 percent of the world's rubber (though post-war resumption of natural rubber production will sharply reduce this balance); our shares of agricultural production are, of course, much smaller, but just before the war we accounted for 35 percent of world cotton production, 15 percent of wheat, and 10 percent of wool.

Whether we like it or not, we must exercise political responsibilities commensurate with the weight of our economic power in an inter-dependent world. But before responsibilities can be assumed, they must be defined. Can the United States arrive at a clear agreement and statement of aims for which it is willing to stand sponsor?

The recent campaigns of both political parties have helped to provide an encouraging answer. In general, election mandates are glaringly deficient as indicators of a unified national purpose. A majority of voters declare themselves for the winning candidate. But even among the majority there are varying degrees of enthusiasm for the platform principles espoused by their candidate; and the substantial minorities of the defeated parties may have had no enthusiasm whatsoever for particular planks in the winning platform, or for the platform in its entirety. A sportsmanlike deference to the will of the majority is a feeble substitute for unified national conviction.

But this Presidential campaign was noteworthy for certain basic principles upon which both the platforms and the candidates of the major political parties were

united. Surely, upon such areas of agreement there may be said to have been an American mandate; the more so, because upon certain of them, we have evidence that no party or candidate could have declared opposition with any hope of victory. What then were these agreed-upon principles? The following is an attempt at a fair summary:

1. That America, in collaboration with its Allies, is committed to seeing the war through to the unconditional surrender of our declared enemies.

2. That America is committed to a responsible role in a world security system after the war, including a commitment to lend the support of our armed forces to repel aggressions that may violate such security.

3. That America is committed to the post-war goal of substantially maintaining in this country an economy that will provide jobs for those who are able and willing to work.

4. That America is committed to the principle of achieving this goal of sustained, high-level employment of manpower and economic resources under a system primarily activated by competitive enterprise.

These are American mandates. They can be made the nucleus of a coherent national policy, for they define aims upon which the great majority of our people are emphatically agreed. But no one can pretend that in this generalized form they serve as more than directional guides for either internal legislation or international negotiation. This skeleton of aims must be clothed with the living flesh of agreed-upon means. Here we have no national mandates of comparable clarity, but it is patently clear that it is our compelling task to achieve them.

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On our elected representatives in government rests the primary responsibility for formulating the specific programs required to implement national policies. Under our system of government, those representatives need continuous nourishment in the form of mandates as to what the people want. Particularly during a period when so many urgent problems are being thrashed out upon an international basis, this imposes a grave responsibility upon all sectors of our citizens; for it requires them to think in terms of the welfare of our nation as a whole, to focus upon those points which offer possibilities for substantial agreement among Americans, rather than upon matters of individual, group, or sectional advantage.

In earlier editorials I have tried to define a basis for national policy in keeping with that broad purpose. They have dealt with problems that are basic to the healthy functioning of free enterprise under the competitive system, with the mobilization of our resources for war and for reconversion to peace-time production, with labor and management responsibilities and relations, with national debt and taxation, with foreign trade and our economic relationships abroad, with the industrial development of backward areas. Since they have been presented in the McGraw-Hill publications, which reach a group broadly representative of all American industry, they have centered upon problems that have an economic rather than a strictly political import.

Future editorials, to appear during 1945, will deal with comparable subjects selected in recognition of the urgent importance for arriving at concerted definitions of national policy. I am fully aware that no individual or group can speak authoritatively for the American Nation. But I hope that an honest attempt to formulate sound concepts of national interest in crucial economic matters will help to crystallize American policy both by focusing agreement and by eliciting dissent.

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Here there is space only to indicate in broadest outline what I conceive to be desirable foundations for an economic policy for the United States:

1. The attainment of a high and sustained level of business activity and employment in the United States and in the world.

2. Active and expanding markets for world trade based upon fair competition rather than upon bloc agreements, discriminatory preferences, and cartel arrangements.

3. The encouragement of industrial development in nations that have been backward in that respect.

4. A recognition that hospitality to imports, rather than constituting a threat to national standards of living, offers in fact the most potent instrument for international bargaining that any nation can command.

5. A willingness to assume a responsible national role in international arrangements designed to provide such financial stability as may be needed to support mutually advantageous world exchange of goods and services.

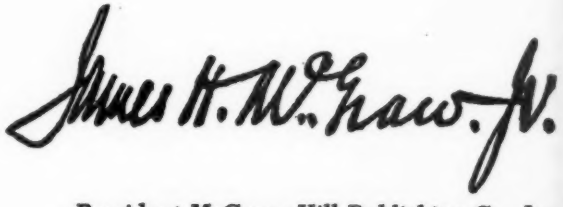
We must see to it that the end of military warfare does not merely open the door to an era of economic warfare.

The fact is that America has no choice but to assume leadership in world affairs. For the weight of our influence will be felt by other nations no less whether our attitude be positive or negative. And the cost to us of any international obligation which we might undertake must in all fairness be weighed against the equally real cost to us of dealing with measures that others may take to protect themselves against the results of our non-participation.

We have tended in the past to approach international commitments timidly, fearful that we might be outwitted in a world battle of wits. And in so doing, we have too often ceded to others the initiative of suggestion, leaving to ourselves the thankless task of accepting or rejecting what they demand of us.

Our one bargaining weakness stems from the fact that other nations, by contrast feeble in potential power, know what they want and are able to mobilize all their strength to achieve it.

America can be the most effective nation on earth—if only it knows what it wants.



President McGraw-Hill Publishing Co., Inc.

THIS IS THE 31st OF A SERIES

Condenser Doctor Puts Monkey Glands Into Aging Tubes

Because Sam Pennella tackles with zest the tiresome, dirty job of retubing and repacking, Associate Editor Tucker reviews here some of the condenser doctor's practical ideas

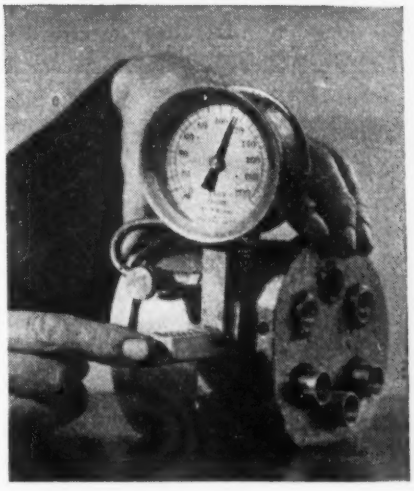


Fig. 1—A 6-tube vest-pocket condenser demonstrates how to pack tubes quickly, and immediately pressure tight

▶ YOU WOULD HAVE to know Sam Pennella firsthand to understand why the experts listen respectfully when he talks about condensers. It is not entirely that he talks the direct shirtsleeve language of the turbine-room basement, nor altogether because of his background of 35 years as a specialist in packing condensers. Mostly they listen because he can make people believe that there is something new under the sun after all.

Sam started business when steam condensers were just a mass of closely spaced tubes in a cast-iron shell. His specialty was, and still is, one of the tiresome and dirty jobs around every power plant that crops up unavoidably at intervals, pulling out old tubes, putting in new tubes and packing the tube sheets to water tightness against a near-perfect vacuum.

Two problems kept knocking at the practical Pennella brain. First, operators were always in a hurry to get a machine back in service; repacking took too long. Second, many of the tubes removed were perfectly sound except for the first few inches at their inlet ends.

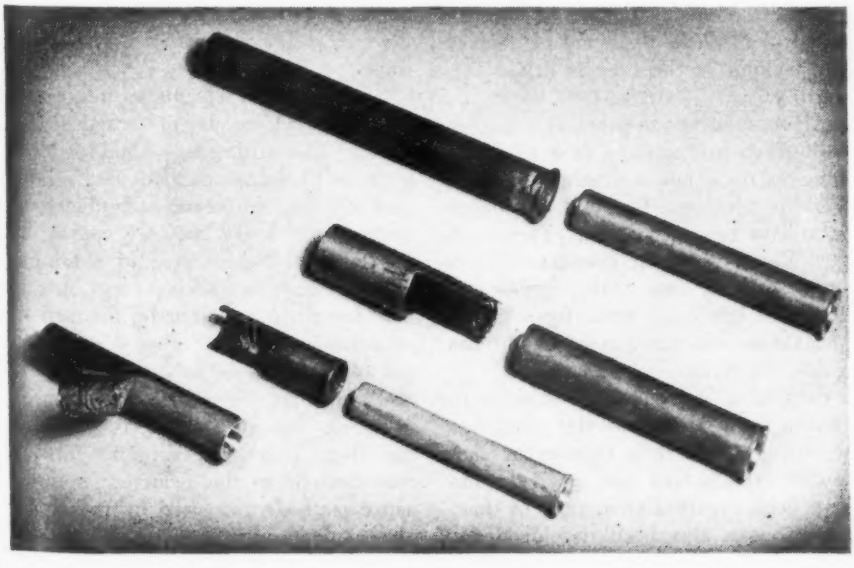
In April, 1939, POWER reviewed seven variations of methods for inlet packing and four for outlet packing. All of the inlet methods require rotary motion for packing and skill to avoid crimping or overrolling the tube. Pennella's contribution is a packing driven directly into the space between tube and tube sheet without rotary motion.

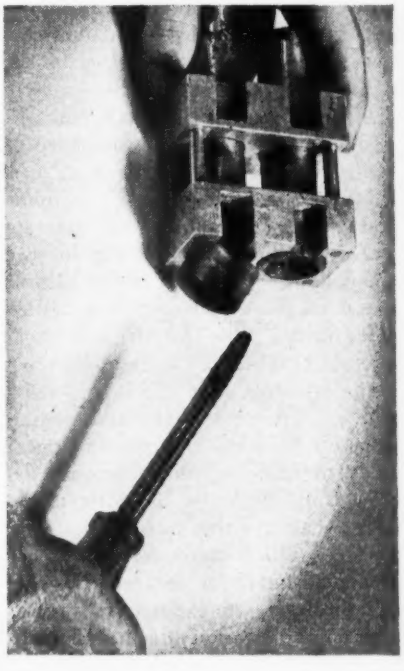
The packing is best illustrated by Fig. 5, which shows a pocket version of a standard threaded tube sheet that can be opened after packing to show the locking effect inside. Machined from fiber tubing, the principal element has one end recessed to receive about three turns of lubricated packing. A $\frac{3}{8}$-in. long brass bushing on the inlet face fills the space between tube and tube sheet to improve water-flow conditions at tube inlet. Outlet packing requires no brass bushing. Fig. 2.

Inserted over a pilot or mandrel, Fig. 4, made of steel bar stock (or individual plastic tube for each unit) the packing is driven home by a few blows of an ordinary mechanic's or light air hammer on the special tubular tool. This upsets the fiber ring near the end of the recessed cut, Fig. 5, immediately sealing the clearance opening between fiber and tube sheet.

Thus a condenser can be operated as soon as packings have been installed

Fig. 2—*(right)* Screwdriver-like sharpened tool removes packing quickly. Fig. 3—For tubes already pitted at inlet end, these fiber-covered brass sleeves give new lease of life by swelling when wet to seal against punctured tube wall





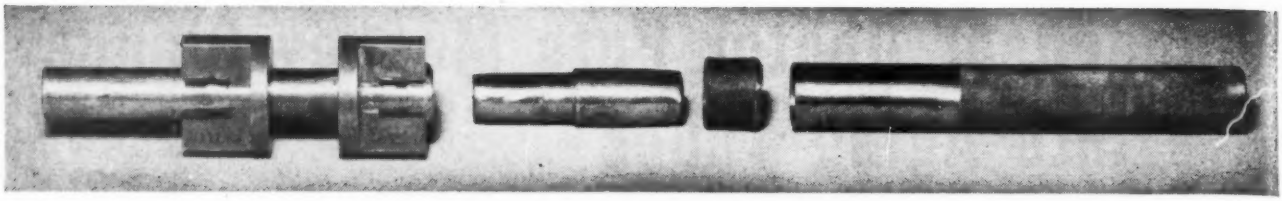


Fig. 4—Mandrel, section of tube and a hammer are tool kit needed to drive home either inlet or outlet packing. Outlet has no brass bushing, more packing

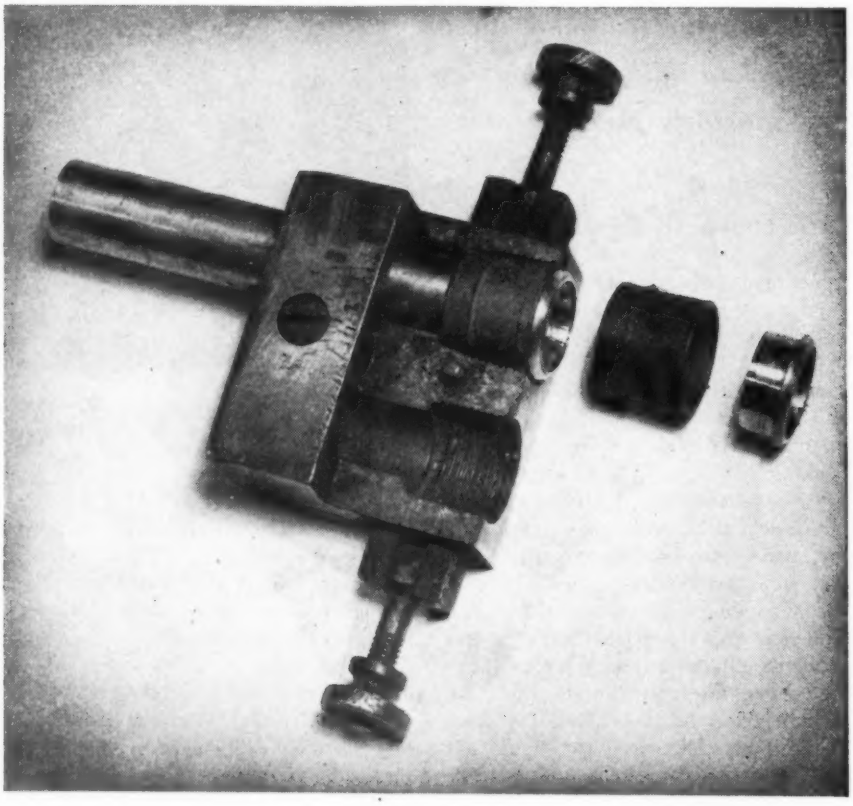


Fig. 5—Inlet packing, primarily fiber with inserted brass bushing and lubricated packing, is upset to form ridge against threads of tube sheet

without waiting for packing to swell. For those who doubt, Sam will bring out his miniature condenser, Fig. 1, and pack any of its six tubes on the spot, drop tight against 200-psi water pressure. In addition to having a tight condenser immediately, Sam says he can beat any four men using other kinds of packing or rolling methods and he doesn't care if threads are damaged or even if there are no threads at all.

The "condenser doctor" sprouts ideas faster than his own staccato words. Another practical way to save money, he proposes, is to buy condenser tubes several inches longer than needed to let excess tube length project at outlet end. Then, as inlet erosion begins to take toll, tube life is prolonged by driving tubes forward and cutting off the eroded section. Pennella's packing is designed so the tube may be driven from the outlet end without disturbing seals at either tube sheet.

When a tube is driven forward an additional advantage is secured by twisting it 90 degrees to expose new surface to the point of erosion attack. Tubes can be driven and turned several times to add to tube life.

Experience with extended tubes in outlet water boxes indicates that a light eroding action takes place in some instances. For this Pennella developed an inexpensive plastic skirt that hugs the exposed portion like a sweater, keeping the outside surface of the tube smooth and clean so as not to damage the packing as the tube is driven forward.

All these ideas are properly classified as "preventive" maintenance of tubes, things to do in new condensers or when retubing to make tube metal live longer or to save time in packing. There are, says Sam, more old condensers than new ones, and more partly eroded and holed-through tubes than fresh metal. For these, the condenser doctor has temporary relief.

Coating of inlet ends of tubes with various types of under-water paint has become practice in a number of condenser installations and good results have been reported from time to time. Inserts have also been developed for installation in new tubes to help prevent erosion. The Pennella version, however, is a brass sleeve, flared at the inlet face and covered with a fiber tube layer. The fiber swells when wet to press tightly against the inner surface of the failed tube and thereby patch existing holes or prevent formation of new ones.

They require no particular skill in installation, being simply driven home in the tube until the inlet flare wedges against the tube face. They are not intended as preventive devices but are a corrective measure to cure an already bad condition for tubes that otherwise must be scrapped. They may be stored for use as needed because the fiber covering is not materially affected by atmospheric conditions. A routine cleaning is advisable before installation but it is not necessary to dry out the condenser.

Experience with these "stopleaks" has been obtained at several Eastern power stations from one of which the tube samples of Fig. 3 were taken. Even where severe pitting has occurred, as noted in several of the samples shown, the stopleak has been found to keep condenser leakage within reasonable limits.

Sam Pennella presents an interesting study of self-developed practical ingenuity specializing in a single field to improve time-worn methods and relieve part of the unnecessary drudgery of power-plant operation. Of course he has taken the precaution of obtaining patents for the packings and inserts here described as well as for the method of driving extended tubes forward to cut off eroded sections. He believes, however, that his work as condenser doctor is hardly started as yet and that there is lots of room for further contributions to the recurring maintenance methods now used in and about power plants.

Continuous Circulation and Filtering Save Engine Lubricating Oil

J C Albright, Santa Monica, Calif., outlines a system for continuous circulation and filtering of highly refined lubricating oil. Thus heavy-duty, gas-engine-driven compressors stay in service without periodic shutdowns for crankcase flushing and refilling with new oil

▶AN ENGINEERED METHOD of continuous circulation of crankcase lubricant, combined with adequate and positive filtering, operates engine-driven compressors without periodic shut downs for flushing sumps and refilling with fresh oil. Lubricating oil in this system flows continuously from the makeup reserve through all engines back to the used-oil receiver from where it is pumped through positive full-flow filters back to the engines again. All foreign particles, such as minute slivers of bearing metal, are removed. Oil circulates so fast that none of these particles precipitate to the crankcase bottoms around individual engine oil pumps.

The new system keeps the crankcase full of oil as did the previous system. It provides sufficient lubrication for several hours' operation with pump-feed and splash oiling if the circulating system is out of order or must be shut down. A large vertical tank *S*, Fig. 1, contains the reserve oil. Bulk deliveries are also made to this tank, from which oil flows to a horizontal receiving tank in a concrete-lined pit *C* below ground level. Locating the receiving tank here permits oil to flow by gravity to it from the reserve tank and compressor crankcases.

System Arrangement

An automatic liquid-level control, Fig. 4, attached to one end of the receiving tank regulates makeup-oil flow, to maintain a predetermined level in the receiver. A small 6 x 4 x 6-in. duplex steam pump *P*, installed near the concrete-lined pit, Fig. 1, circulates the oil. Discharge-line pressure controls pump speed to maintain a full head to the engines.

Pump discharge connects through a manifold to a double filter *F* arranged so that one unit may be cut out to clean or change filter elements. Piping provides direct circulation to the engines, bypassing both filters in an emergency. Filtered oil flows through a 2-in. pipe to a header *H*, Fig. 3, supported on the lower members of the engine-room roof trusses. From this header, risers *R* lead to controls at the crankcase covers. Stopcock *C* above a sight-feed indicator *S*, Fig. 2, in each

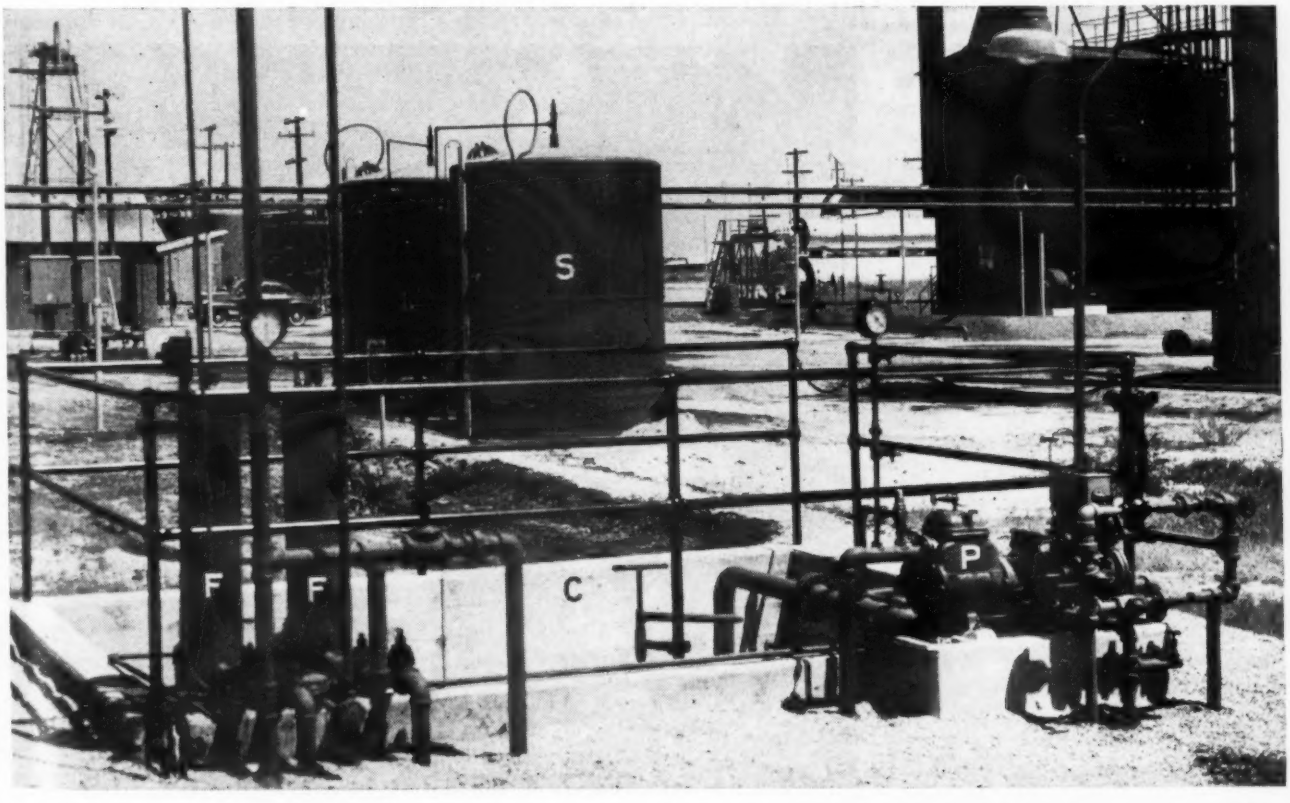


Fig. 1—Pump *P* forces new gas-engine-compressor lubricating oil, stored in tank *S*, and used oil, received in horizontal tank in concrete pit *C*, through filters *F* back to oil main in plant-roof trusses from where it flows to the engine crankcases

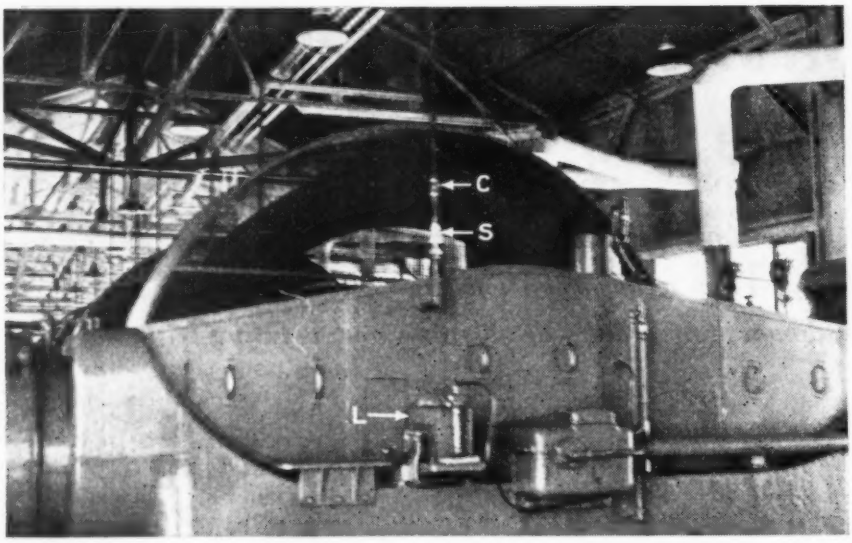


Fig. 2—Sight-feed indicator *S* shows engine-room operator rate of filtered-oil flow to engine crankcase while its pump supplies cylinder forced-feed lubricator *L*.

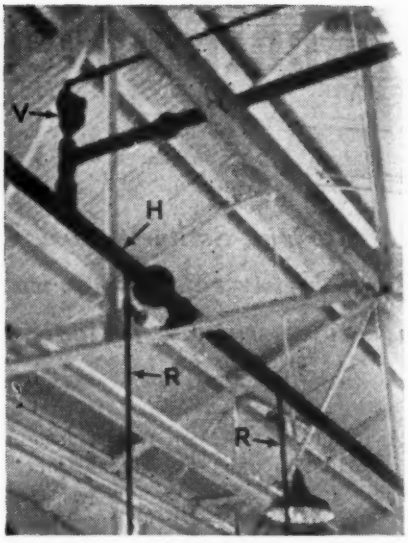


Fig. 3—Overhead oil-distribution header *H* with air-vent valve *V* above engine-compressors

riser permits the operator to regulate oil flow to the engine. Air and gas are vented from the oil-distribution header above the engines through a conventional vent valve, *V*, Fig. 3, allowing vapors and entrained oil to return to the used-oil receiver.

Forced-Feed Lubricator

Once oil flow is adjusted to suit engine requirements, lubrication is practically the same as with a conventional system. Engine circulating-oil pump delivers lubricant to its main bearings, crosshead slides and crankpins. A tap from the pump discharge also delivers oil to the cylinder forced-feed lubricator *L*. A stopcock in the line near the lubricator case controls oil flow to it. Some of the forced-feed lubricators had two compartments, but were converted to one compartment by drilling an equalizer hole in their dividing wall, so that both sides receive the same oil quantity. An overflow line dumps excess oil back to the engine crankcase. This line permits the engine oil pump to deliver an excess of oil to the forced-feed lubricator so that it never runs dry.

An overflow line attached to the oil-sump base rises high enough beside engine bed to insure adequate oil reserve in the engine crankcase. Each side of a horizontal twin engine has similar fittings so that adjustments can be made if one side requires more lubricant than the other. Taking the crankcase overflow from the lowest point of the sump insures that all oil leaving the engine washes the crankcase floor. This oil sweeps any precipitated foreign matter along with it to the receiver tank outside the engine room.

Advantages of the system are obvious. No measuring cans are needed to fill engine crankcases or forced-feed lubricators. By starting with a highly refined oil from which all asphalt and waxes have been removed, the lubricant in circulation is maintained in good condition. Bearings are supplied with oil free of foreign matter, which insures bearings running cool and reduces failures. There is no refuse oil to dump from the crankcases by periodic flushing. Only oil not returned to the receiver is that pumped by forced-feed lubricators to gas-engine and compressor cylinders.

In addition, the system requires minimum attention, which is important in today's labor shortage. Aside from occasionally adding makeup oil, the system is practically automatic after it is once correctly adjusted.

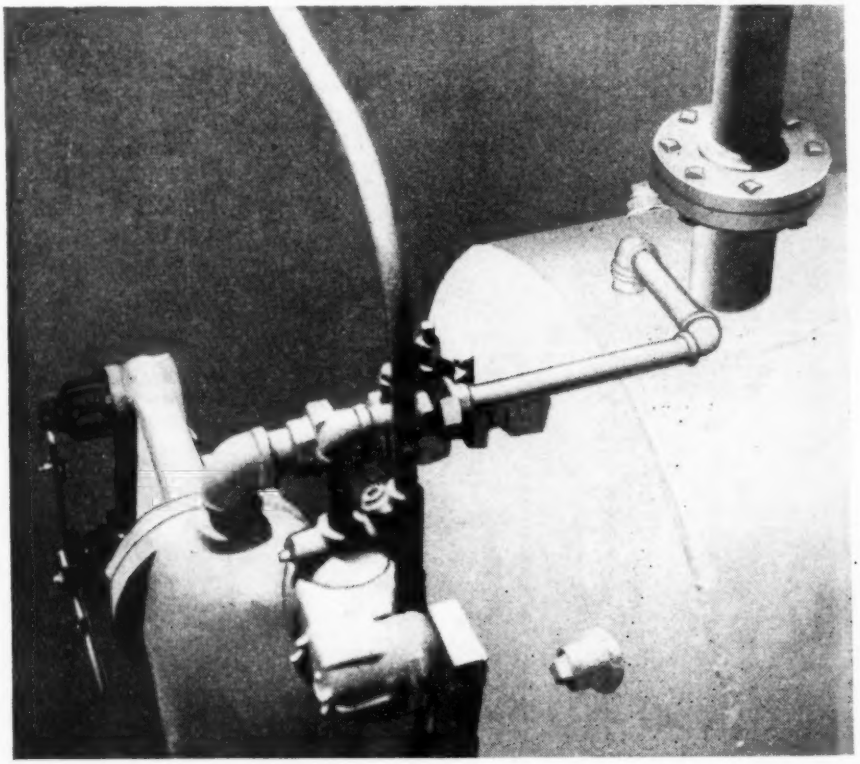


Fig. 4—Horizontal used-oil receiver tank has a liquid-level controller that maintains oil level to insure adequate circulation to gas-engine compressors in the plant

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

For Good Brush Performance Keep Down Commutator Temperatures

W C Kalb, service engineer, National Carbon Co, explains sources of excessive heating in machines and noisy brush operation, and tells how to remedy these faults to improve brush performance. Third and last in a series of articles

OVERLOADING most frequently causes excessive heating of dc generators and motors but other conditions also produce excessive temperatures in machines operated within rated load. Among these are unbalanced armature currents, winding faults, friction between brushes and commutator, impaired ventilation and other causes that affect brushes.

Sparking at brushes raises commutator temperature and is a cause of overheating. Most sparking causes, such as heavy short-circuit current during commutation, produce excessive temperature in the machine. Incorrect brush position, unequal brush spacing, faulty interpole adjustment, brushes too thick, brush holders misaligned, unequal air gaps and too-low voltage drop across brush contact are among the commoner causes of heavy currents in the commutator and the brush faces.

Unbalanced Currents

Unequal air gaps or pole spacing unbalances armature current. Unequal brush spacing has a like effect. Open or high-resistance connections at the commutator or cross-connections, too few cross-connections and faulty parallel operation with another machine are other sources of unbalanced current in the armature circuits. In addition to overheating the windings, unbalanced armature currents tend to increase armature-core hysteresis and eddy-current losses.

Open or short circuits, grounds and high-resistance connections, in either field or armature windings, are all potential sources of excess heating. Most maintenance shops can usually locate such faults.

Excessive commutator temperature sometimes results from high friction caused by high coefficient of friction brushes or by brushes not adapted to high peripheral speeds. Wedging effect

Fig. 1—Angle of inclination that the brushes make with the commutator has a marked effect on the heat generated at their contact face on the commutator

of brushes operated in a trailing position, Fig. 2, at too great an angle tends to raise commutator temperature seriously. A raw commutator has much higher friction than one with a good oxide film. Therefore, protect the commutator from "contact poisons" such as carbon tetrachloride, smoke, acid fumes, vapors released by hot insulation and other vapors that cause atmospheric contamination injurious to oxide film. Low humidity, excessive brush pressure, large brush area on commutator and dirty commutator surface are other causes of increased frictional heat in the commutator and brushes.

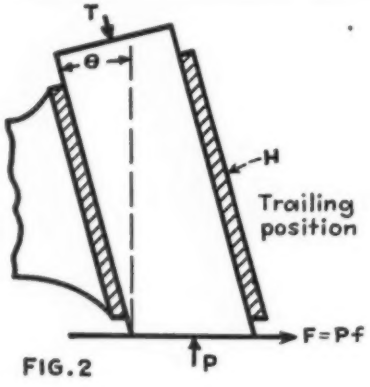


FIG. 2

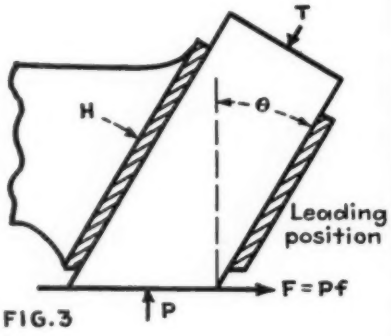


FIG. 3

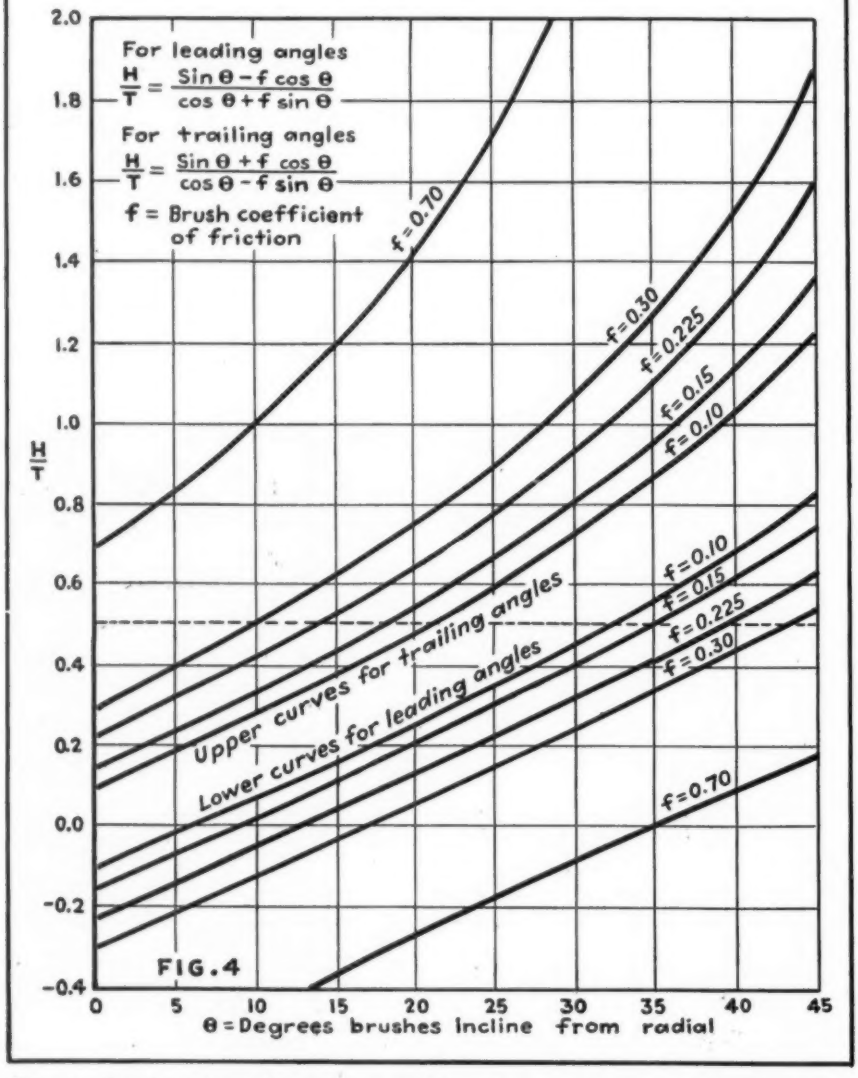


FIG. 4

Fig. 2—Brush inclined in trailing position from radial on commutator. Fig. 3—Brush inclined in leading position. Fig. 4—Curves give values by which spring tension is multiplied to obtain brush pressure against its holder's side

All energy losses with a generator or motor appear as heat, which the machines must have sufficient ventilation to remove as rapidly as it is produced; otherwise, dangerous temperatures develop. Keep ventilating ducts clean by blowing out frequently. Ventilating passages are likely to clog rapidly, therefore, if possible, protect machines from atmospheric dust by inclosing a box or hood into which ventilating air is drawn through a filter or from a clean source. If you cannot do this, remove the armature at regular intervals to clean the ventilating ducts.

Individual brushes sometimes heat as indicated by glowing or incandescent spots at brush faces; raw streaks on commutator surface, unequal brush pressure and loose shunt connections are among the commoner causes of selective brush heating. Lower-contact-drop brushes have sometimes relieved commutator heating on machines of good commutating characteristics.

Sources of Brush Noise

Chattering usually causes noisy operation of brushes, even though frequency of brush movement may sometimes be so high and separation between brush face and commutator so slight that no visible sparking results. On some small, high-speed motors with undercut commutators the rapid passage of the slots under the brushes may produce an audible tone without disturbing contact between brushes and commutator.

Practically any commutator-surface fault, such as a rough or dirty surface, high mica or mica fins, high or low bars, burned bars and flat spots, causes chattering and noise.

Chattering caused by high brush friction on the commutator is usually of higher frequency than that caused by commutator-surface faults and the noise often has a clearly defined tone, sometimes of very high pitch. Look for low-average current density in brushes, low humidity, contact poisons, and wrong brush angle when high friction may be a probable source of noisy brush performance.

Brush composition influences quietness of operation, some grades being inherently quieter than others. Harder carbon and carbon-graphite grades are most susceptible to noisy operation, while graphite brushes are usually quiet. Electrographitic grades, in general, operate quietly because of their low coefficient of friction. If a grade of relatively low commutation factor is noisy on a commutator in good condition and with high-friction causes eliminated, a higher-commutation-factor

grade or one of greater film-forming properties may improve operation. If streaking or a raw commutator surface develops, primary trouble may be faulty commutation, atmospheric contamination or low-average current density. Usual methods to correct these conditions of brush operation were discussed in the first of this series (Nov, p 759).

Effects of Brush Angle

Angle at which brushes rest on commutator may have a marked effect on the heat generated at their contact face. It may likewise have an influence on how quietly they operate. Firm contact between brush face and commutator is essential. While contact intimacy is influenced by brush-material characteristics, it also depends on several factors associated with the way brushes are held against the commutator. To secure firm contact at all points on brush face, brush holders must be securely mounted and pressure fingers must not cause a side thrust toward either brush edge. Brushes must also be free to move lengthwise so they can easily follow minor commutator-surface irregularities.

When these details are taken care of, consider the effect of the various forces applied to the brush. Obviously, these should prevent a change of angle at the brush face because tipping reduces contact area to a narrow band on one side. Relationship of the forces acting on a brush is a function of the angle at which it rests on the commutator. Fig. 2 and 3 indicate the four primary forces acting upon a brush:

T = Spring tension in a direction parallel to brush length.

H = Restraining pressure of brush holder against side of brush.

P = Resultant pressure normal to commutator surface at brush face.

F = Frictional pull at brush face tangent to commutator surface.

Fig. 2 shows a brush operating in trailing position, that is, with commutator revolving away from sharp edge of brush face, and Fig. 3 a brush held in leading position, with commutator revolving toward the sharp angle at its face. θ, angle at which brush inclines from the radial position, is the same as the bevel at the brush face. F, the frictional pull at the brush face equals pressure P, times coefficient of friction f between brush and commutator.

Fig. 4 shows the value of $\frac{H}{T}$ at various brush angles in the two operating positions, trailing and leading. Curves are drawn for five different coefficients of friction f, 0.10, 0.15, 0.225, 0.30 and 0.70. Value $\frac{H}{T}$ is obtained by formula in Fig. 4 and represents the factor by which spring tension T is multiplied to obtain brush pressure H against its holder side.

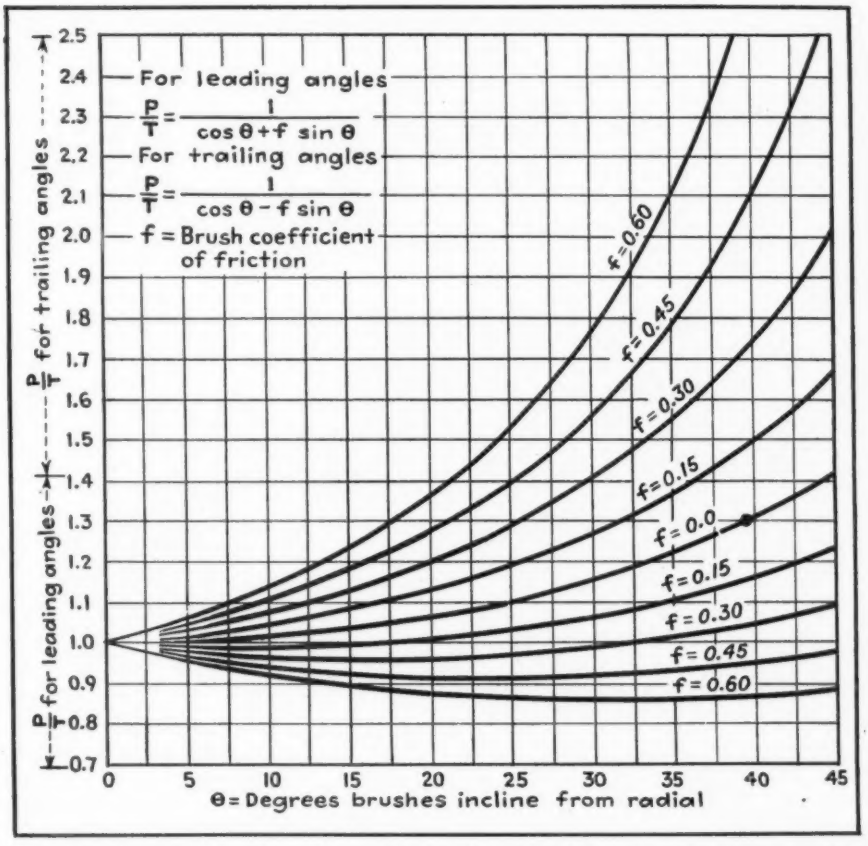


Fig. 5—Curves give values by which the brush-holder spring tension is multiplied to determine brush pressure normal to the commutator at the brush face

For example, assume a brush coefficient of friction of 0.15, operating in the leading position with its face beveled 30 deg. Fig. 4 shows corresponding value of $\frac{H}{T}$ to be 0.4, then brush pressure against its holder side at a 3-lb spring tension T is $H = 3 \times 0.4 = 1.2$ lb. A brush with the same cofficient of friction, operating at a 15 deg trailing angle and same spring tension, would have a side pressure $H = 3 \times 0.43 = 1.29$ lb.

With trailing operation, $\frac{H}{T}$ is always positive. For leading operation, however, all curves cross the zero line. Angle represented by the point at which a given curve reaches zero value is the critical one for a brush having the coefficient of friction represented by that curve. At a smaller angle, or an increase in coefficient of friction, the frictional pull F away from the brush-holder side becomes greater than force P tending to hold the brush there. The brush, therefore, tips onto its leading edge and either chatters or is held out of contact with the brush-holder side.

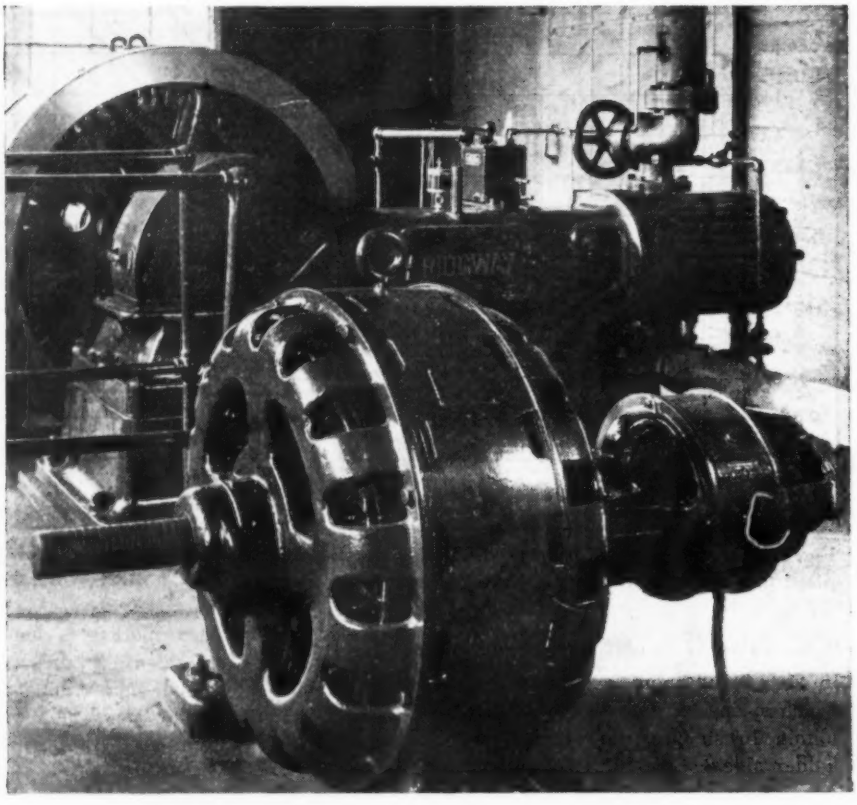
Freedom of brush motion is hampered by excessive pressure against its holder side. For good operation, side pressure should not be more than 0.5 tension-spring pressure applied to brush top. That is, value $\frac{H}{T}$ should preferably not be greater than 0.5, indicated on the curves, Fig. 4, by horizontal dotted line. From the curves it is easy to determine brush-angle and coefficient-of-friction combinations at which this suggested limit is reached. In current practice brush holders are seldom set at trailing angles in excess of 20 deg. while 15 is a more common setting. Maximum leading angle in general use is 37.5 deg but 30 is probably representative of average practice.

Equal in importance to freedom of radial movement is freedom from a tendency to tip and disturb brush contact on commutator. Since force H is always positive in trailing operation, a tendency for the brush to tip develops only when brush holder's lower edge is too far from the commutator or when spring tension tends to push brush top away from brush holder's trailing side. Sometimes the top is given a slight bevel to keep brush in contact with holder's trailing side. This practice in-

(*Continued on page* 154)

Plant-Tested Methods and Ideas for Power Men

PRACTICAL Aids to Operation



OLD GENERATOR IMPROVES POWER FACTOR

WE OPERATE a 50-kva 3-phase steam-engine-driven ac generator during the heating season. When we first started operation with this machine we found it impossible to maintain good voltage regulation, even with full exciter voltage across the field coils. A check showed the power factor to be about 0.63, which accounted for the low voltage, because the generator was designed for 0.80 pf.

Something had to be done to improve the power factor. We could not make the necessary change in the production-machine motors except at high cost. Most of the motors are small and many of them drive machines that are loaded intermittently. We therefore decided that the power-factor improvement job had to be done at the power-plant switchboard. A 50-kva 720-rpm 0.80-pf second-hand generator with a direct-connected exciter was purchased at low cost and installed to operate as a synchronous condenser, as in the photo. At maximum load on the plant this machine improves power factor to about 0.90.

The synchronous condenser is connected directly to the generator leads through a disconnect switch that has not been opened since before the machine was started. When engine and generator are started slowly, the synchronous condenser comes up to speed slowly and pulls into step with the generator without the least difficulty.

Englewood, N. J. R BOETTINGER

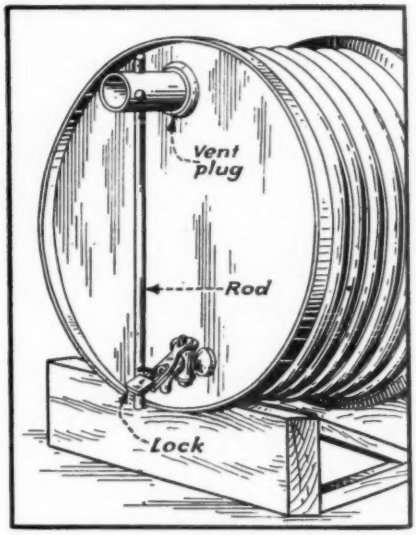
Repairs Controller With Copper Roof Flashing

BECAUSE OF THE SHORTAGE of equipment parts and materials many a resourceful engineer has taken strange paths to keep his plant running. Our laundry wheel gave up the ghost because the middle contact entirely wore away on the controller reversing mechanism. We operate seven days a week, with no time out for repairs, and are miles away from another laundry. Fortunately, I was able to get the wheel going in a short time with a thin strip of copper roof flashing, tripled for strength, bent to the proper shape and slotted to slip under the holding screw.

Peterborough, N. H. A H PARKER

Shop-Made Drum Locks Prevent Oil Thefts

SMALL BUT CONTINUOUS LOSSES by theft of lubricating oil, gasoline and solvents stored at several exposed points of a plant's yards prompted one superintendent to find a means of locking the



drums to make them tamper-proof. While the spigots were locked, access to the drums was gained through vent openings.

To prevent this, the welder connected a 4-in. long nipple of 2-in. pipe to the vent in each drum and drilled ¾-in. holes 90 deg apart through the pipe near its free end. To one end of 2-ft lengths of ¾-in. steel rod he welded a chain link at right angles to each rod. Free ends of these rods were put through a hole in the pipe nipples on the vent plugs and the other ends locked to the spigots as in the sketch.

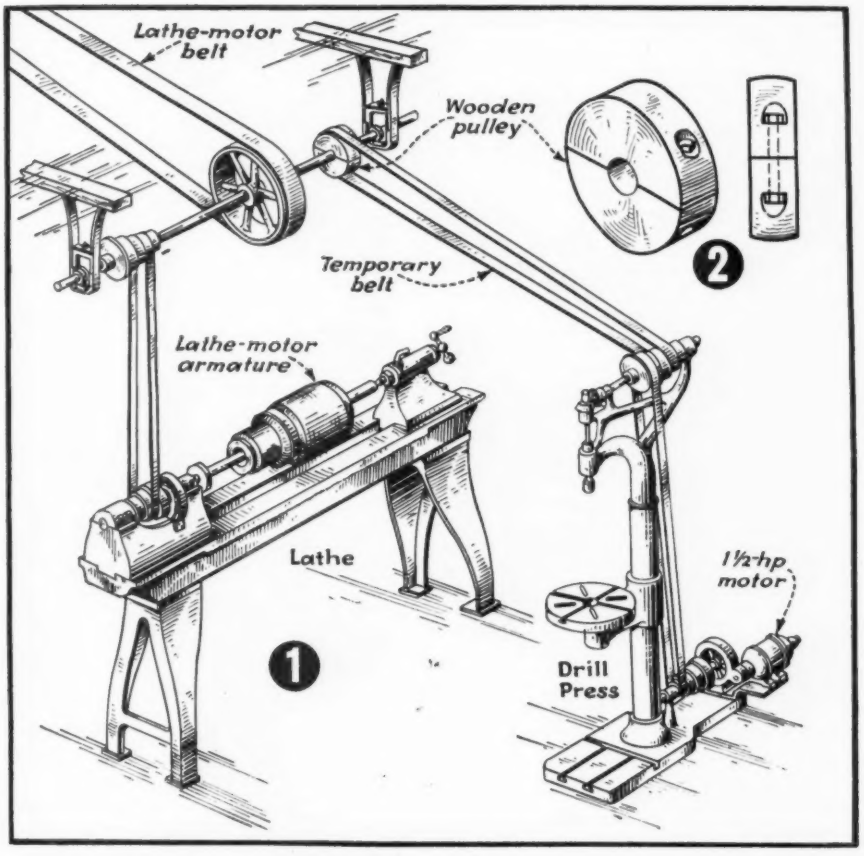
An advantage of this lock is that the plugs may remain unscrewed a turn or two for vent purposes while still allowing the drum to be locked against possible theft.

Pomona, Calif. G M WILSON

Makes One Motor the Conditioner of Another

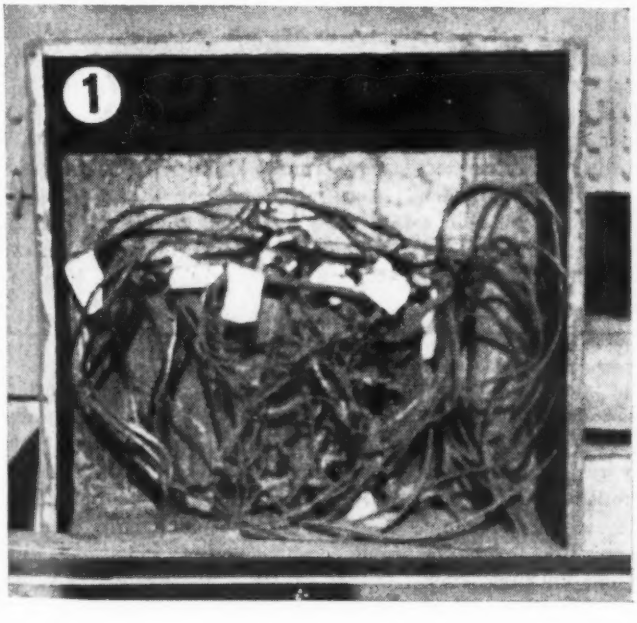
WHEN OPERATING PLANTS in out-of-the-way places an engineer's head is his best friend. In a small machine shop a lathe and grinder were driven by a 7.5-hp dc motor and a drill press by a 1½-hp motor. Commutator of the 7.5-hp motor was in bad shape and had to be trued in a lathe. No lathe was readily available but our own. We therefore had to find some way to drive it to true the commutator.

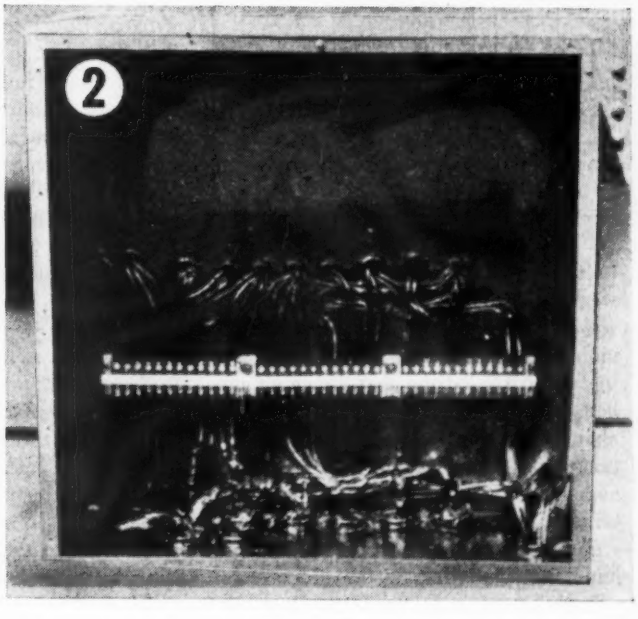
We made a 10-in. wood pulley, bored a hole in its opposite sides for clamping bolts, Fig. 2. We then bored the center of the pulley for the lineshaft size and sawed it in two for clamping in place. With the wood pulley installed we connected it to the drill-press pulley with some old belting. We then removed the 7.5-hp motor's armature and with the drill-press motor driving the lathe we trued the commutator on the armature as in Fig. 1.



The armature revolved more slowly than it might in practice but fast enough to give the commutator a polished surface. Before we reassembled the motor we thoroughly cleaned it and undercut the commutator's mica.

Great Neck, N. Y. S M ELONKA





TERMINAL BOARD SIMPLIFIES ELECTRIC CIRCUIT TESTING

JUNCTION BOXES, unless provided with a terminal board, are likely to become a tangle of wires like that in Fig. 1. In this box, connections were made in control and signal circuits run in underground conduit, and wires for the same circuits run in conduit above ground. It was difficult to locate trouble in these circuits because of the way the wires were tangled in the junction box.

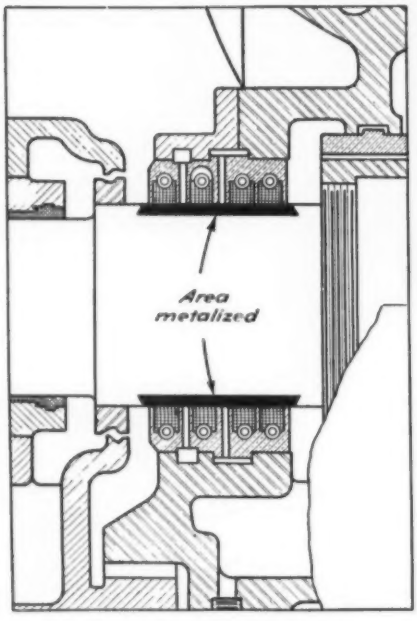
To correct this condition I installed in the junction box a terminal board,

Fig. 2, which is a vast improvement over Fig. 1. We have found standard terminal boards, which are satisfactory on 110- or 220-v ac, may not have sufficient insulation for 250-v dc. When installing a dc terminal board in a junction box exposed to dampness or dirt we use every other terminal and mount the board ¼ in. clear of ground. This insures high insulation between terminals and between terminals and ground.

Troy, N. Y. GILBERT LINDGREN

Metal Spraying Saves Turbo-Blower Shaft

Two 5000-HP 60,000-cfm 30-psi turbo-blowers supply air to blast furnaces. One of these blowers had to operate continuously seven days a week so the



units operated alternately to divide wear on them. Because of steam leakage at the throttle of one unit when idle, moisture accumulated at the shaft packing and corroded the shaft, causing carbon packing and shaft to seize. After about eight years' operation shaft sections in the packing were worn so that a good packing fit could not be maintained.

To correct this condition a new shaft had to be installed or the old one repaired. Under war conditions the blast-furnace company could obtain a new shaft only on very long-time delivery so our engineers were called in to consider building up the shaft with metal spray and resurfacing it to the proper diameter. The company decided to handle the job in their machine shop, but did not have a lathe large enough to swing the turbine spindle, so they removed the wheels.

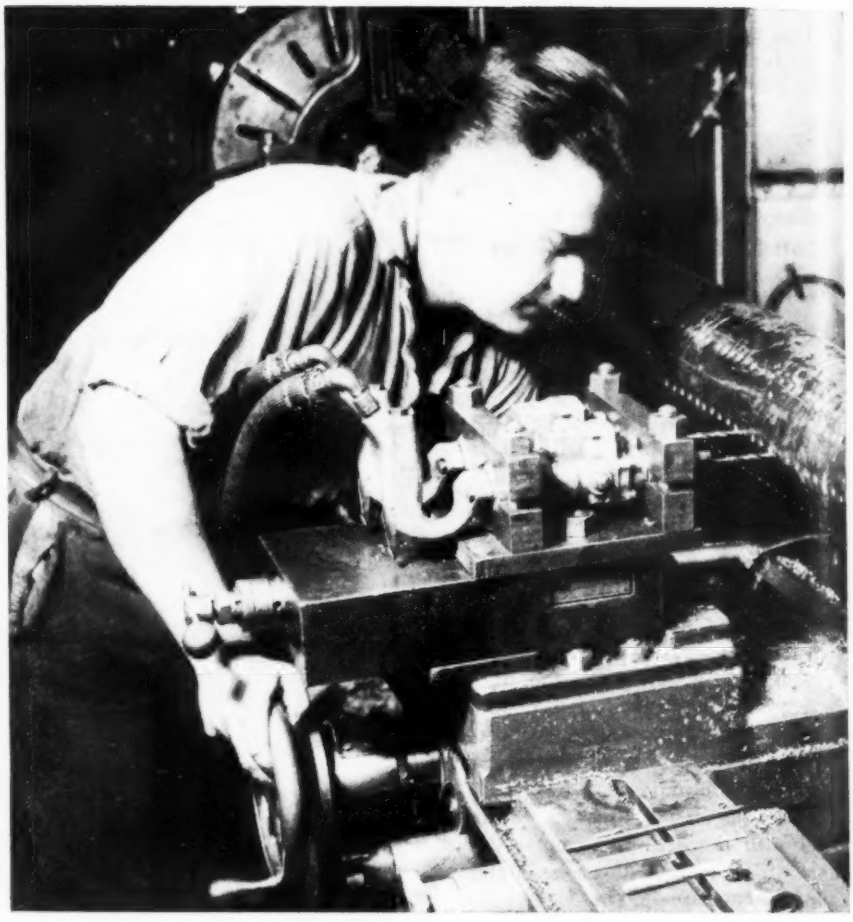
The shaft was then placed in the lathe with a steady rest at its center after which its corroded sections were turned down to an even surface. These surfaces were then prepared for metalizing by threading and knurling after which they were sprayed with stainless steel to build them up to oversize. This steel is so hard and abrasive resistant that it had to be ground to finished size. The drawing shows the metalized area on shaft section. These shafts were inspected after they had operated one year and eight months. The gland sections looked practically the same as when first installed on the turbine.

This company now uses metalizing to build up motor-armature shafts, piston rods, pump rods, pump-shaft sleeves, valve stems, crane axles, bronze bushings, synchronous-motor slip rings, engine eccentrics, all of which have given longer life than the original material. A bronze pump-shaft sleeve was built up with stainless steel and after six months' service showed scarcely any wear, whereas six months had been about the limit of service for a new bronze sleeve.

Long Island City, N. Y.

W C REID

Vice-pres, Metalizing Engrg Co. Inc



AIR DRILLS SPEED DRAINPIPE DRILLING

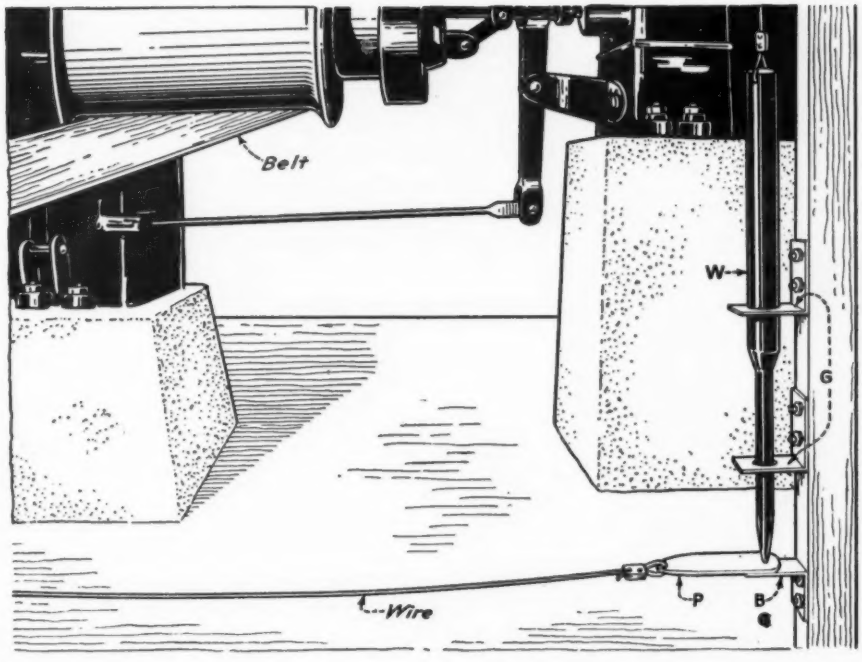
PHOTO SHOWS an engine lathe set up to drill holes in 6-in. drainpipes for surface condensers. The pipes are 18 ft, 6 in. long and require the drilling of 200 holes. A special holder, designed for two properly spaced air-drilling machines, is bolted in the compound tool-holder slot. Two holes are drilled at one time. Hand feed is used to spot the holes and the cross feed engaged to drill them.

With this setup it is necessary to lay out only the first hole in each row. A micrometer stop attached to the tool-holder ways, used with block, plug and pin gages, provides accurate spacing. To move from one row of holes to another, it is only necessary to turn the face plate by hand and align drill to layout.

South Philadelphia, Pa. J BEHAN

Westinghouse Elec & Mfg Co

Automatic Engine Stop Eliminates Fire Hazard



OUR EXPERIENCE shows that in a plant powered by slow-speed engines, operating unattended, a main belt may break and part of it rub against the flywheel until it causes a fire. To eliminate this hazard the superintendent designed and had installed automatic ignition cutouts that function to stop the engine when a belt fails.

As shown in the drawing, each cutout consisted of a wire stretched under the belt. One end of the wire is deadended and the other connects to metal plate *P* resting on metal bracket *B*. Weight *W* is made of 12-in. length of 1½-in. shafting to which is welded an 8-in. length of ¾-in. steel rod. Guides *G* hold the weight vertical while its lower ends rest on plate *P*.

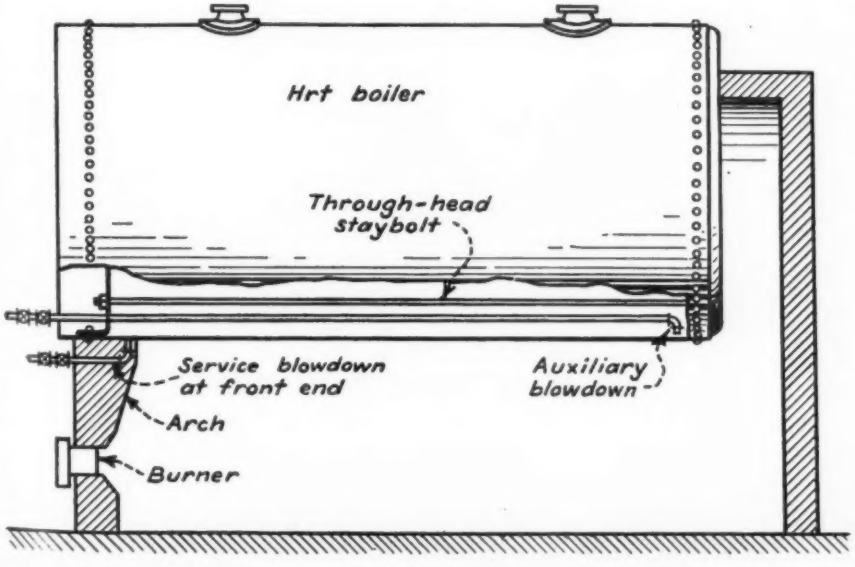
Top end of weight *W* connects by a wire to the release pin that short circuits the ignition-system magneto. If the belt breaks it drops on the horizontal wire and pulls plate *P* from under weight *W*, which drops through a hole in bracket *B* and short circuits the ignition magneto to stop the engine.

Pomona, Calif. G M WILSON

AUXILIARY BLOWDOWN LINE PROTECTS HRT BOILERS

HRT BOILERS fired with oil, gas or pulverized coal are frequently pitched toward the front end to avoid overheating the blowdown pipe at the shell's rear end. It is common practice to blank off the rear blowdown connection with a pipe plug threaded into the riveted pad and then welded for tightness. Sometimes the riveted pad is removed and a plate riveted or welded inside the shell over the blowdown opening.

When the rear blowdown connection is blanked off, one is provided in the front end in the bottom of the shell. This connection must be protected against overheating by arching the refractories over it or by other designs that give the required protection. This connection is necessary for draining the boiler pitched lower at the front end, but it does not prevent sediment accumulating at the rear end. Circulation of boiler water carries sediment to the rear end where it is deposited and may bake to a hard scale. This causes overheating and distortion of the shell plate, because fuels burned in suspension cause quite high temperature over the entire length of the shell.



To remove loose deposits of sludge from the rear end of the shell install an auxiliary blowdown line inside the boiler, as in the diagram. Being inside the boiler, the auxiliary pipe does not have to be protected against overheating. Pipe installation can be made easily with a conventional feed-pipe bushing in the front head. Clamp the pipe to a through-to-head stay and locate it so as not to interfere with inspection or cleaning of the boiler. That is, the auxiliary blowdown pipe should not be between the stays except at the crossover at the rear end.

When installing an auxiliary blowdown pipe observe inspection laws regarding pipe size, strength and connections, number and type of valves, and other details. Use the auxiliary line often enough to prevent serious sludge accumulations at the boiler's rear end. Frequency of auxiliary blowdowns can be determined best by trial and periodic examinations of the boiler's internal surfaces. Under average operating conditions, blowing down through the auxiliary line for one minute once each 24 hr of boiler operation should be sufficient.

Canton, Mass. HARRY M SPRING

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

Questions from Our Readers

1—Needs Help on Pulverized Coal Firing

I AM FACED with the problem of writing operating instructions for our new pulverized-coal-firing equipment. We have one unit for each boiler with a spare for emergencies that is piped to all burner lines. I am well supplied with information on the mechanical operation of this equipment and mainly interested in the safety measures followed by other engineers.

For instance, what is the permissible drying-air temperature when it enters or leaves the mill? What can be done to prevent fires in coal piping? What causes fires and what is the best way to extinguish them? Should the practice of lighting a burner from another or from the hot refractory be absolutely prohibited or just warned against? I have certain ideas about these points but would like to have the advice of other engineers.—*FCL*

2—Why Does Ice Crack?

WE EXPERIENCE considerable trouble with cracked cakes when we harvest our ice. Varying brine temperature between 12 and 16 F does not correct the trouble. We have been advised to use CO_2 in the water before putting it in the cans. Is this considered good practice, and if so how is the gas piped to the filling tank? It is my understanding that CO_2 in water corrodes pipelines. Does it corrode ice cans?

At present the cracking causes us considerable loss, and we would like suggestions as to what may be causing it and what possible corrections we can make.—*FSW*

Answers to November Questions

Can We Stop These Pipe Failures?

(This is Question 1 from the November issue, with best answers from readers.)

Water supply for our laundry comes from an 8-in. main at 100 to 150 psi through a 2-in. branch fitted with a pressure-reducing valve. This valve reduces supply pressure to 55 psi for direct feed to washing machine. On washing machine side of the reducing valve a 4x48-in. air chamber connects to the water line as a protection against violent surges in the line.

Amount of water drawn to fill the washing machines varies from 50 to 200 gal and when full mark is reached the regulating valve closes suddenly.

We have considerable trouble with ¾-in. lead bends, connected to the 8-in. line about 300 ft from the laundry, that burst open, presumably from excessive pressure. Is this trouble caused by the quick-closing pressure-regulating valve? What can we do to eliminate the trouble?—GFJ

Make Pressure Survey

I SUGGEST that GFJ use an engine indicator to take pressure readings at as many points as possible, covering several cycles of washing-machine operation. This determines whether the reducing valve is actually causing the surges, and the value of instantaneous pressure variations. Secure an automatic record by arranging a slow-speed drive to move the drum or by mounting a clock-driven chart at the proper angle.

If the reducing valve is definitely the cause, slow its operation by throttling the control line with a needle valve. Also it may be possible to slow down the operating valve on washing machines or change the type of seats to keep changes in flow rates within limits that do not dangerously disturb line pressure.

A bleeder line can be taken from the system to other equipment to give a minimum flow that reduces pressure variation caused by valve operation.

St. John, N.B. C G CLARK

Lead Bends Act As Safety Valves

IF THE FLOW to the washing machines is 100 gpm the added pressure in the 8-in. main may approximate 34 psi. If the flow is 200 gpm the added pressure may approximate 64 psi, and the actual maximum pressure during water surges may be from 180 to 215 psi.

If the quick-closing valve with its instantaneous-closing characteristics is to be left unchanged, take either of the following steps to prevent ruptured lead pipes:

(1) Install an air chamber on the 8-in. main close to the washing-machine takeoff. The present air chamber is of little value in dampening pressure surges in the 8-in. main.

(2) Replace the lead bends with other pipe having adequate strength to withstand the line pressure plus the increased pressure developed when water hammer occurs.

The Lead Industries Association states that extra strong lead pipe has a safe working pressure of 75 psi., while double extra strong safely withstands constant water pressures of 100 psi.

GFJ should realize that the lead bends are acting as a safety device.

Their rupturing prevents destructive pressures on the 8-in. main. If the lead pipe is replaced with stronger material pressure on the main may increase unless an adequate air chamber is provided, or a slow-closing valve installed.

University City, Mo. W V WEIR

Put Air Chamber On the 8-In. Main

CONNECT THE AIR CHAMBER on the 8-in. main side of the reducing valve and use 2½- or 3-in. pipe for the connection, keeping it short and without bends. Be sure the air chamber contains air. It will help if the quick-closing valve is slowed down but the trouble can be overcome with an air chamber if it is large enough and the air cushion maintained.

Carlsbad, N. M. E A ROBERTS

Eliminate the Surges

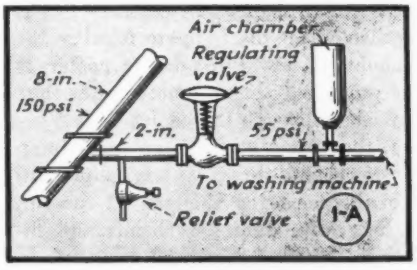
BRANCH FAILURES on the 8-in. main are caused by excess pressure from water hammer which originates at the washing machines. The 4x48-in. air chamber installed on the washing-machine side of the reducing valve protects the 2-in. branch line when the washing-machine valve closes suddenly. Yet when this happens the pressure-reducing valve must also close suddenly to prevent high pressure in the 2-in. line. The violent surges are transferred to the 8-in. main.

Protect the 8-in. main by installing (1) an air chamber on the main or (2) a relief valve to prevent excessive pressures building up. It would be much simpler to prevent these violent surges by adjusting the filling valves at the washing machines so that they close at a slower rate. A difference of only a few seconds makes the difference between smooth operation and violent surges.

Brooklyn, N. Y. JOHN SALVIANI

Install a Bypass Line

FAILURE of the ¾-in. pipes is caused by the sharp pressure wave when reducing valve closes. Bypass the 2-in. pressure-reducing valve with a ½-in. pipe having another reducing valve set to close a few psi above the 2-in. valve. This will elim-



inate the water hammer because the volume of water flowing through after the 2-in. valve closes has very little kinetic energy.

A second method is to install a relief valve ahead of the pressure-reducing valve, sketch 1-A. Relief-valve setting should be about 10 psi above line pressure. This prevents an excessive surge in line pressure, and failure of piping.

A third method is to put an air chamber on the inlet as well as the outlet of the pressure-reducing valve.

West New York, N. J. ANTONIO DI LORENZO

Relocate Air Chamber

GFJ SHOULD CHECK the wall thickness of the lead bends. For the pressure indicated, a ¾-in. lead pipe should be at least 0.29 in. thick, and even a little heavier would be better.

There is no doubt that the trouble can be traced to the quick-acting pressure-reducing valve. There are slow-acting valves on the market that probably would be more satisfactory.

If the present air chamber has sufficient strength to allow operation at the higher pressure, I suggest connecting it to the high-pressure side of the pressure-reducing valve.

Kalamazoo, Mich. E E NORMAN

Use Stronger Pipe Bends

ALLOWABLE WORKING STRESS in extruded lead pipe containing 6% antimony is about 400 psi at 68 F and only slightly over half that at 180 F. Water hammer has only minor effect on the connections at the main but could be expected to expend its energy at the *house* end of the service line.

(*Continued on page* 146)

Will This Pump Do the Job?

(This is Question 2 from the November issue, with best answers from readers.)

Cooling water at 15 psi flows through a double-pipe 2-section cooler and out a 2-in. discharge line to the sewer. We would like to save this water by elevating it to a storage tank 40 ft high with a centrifugal pump having a 2-in. suction. The pump is direct connected to a 5-hp 1720-rpm motor.

We have no other data on the pump and would like to know how we can determine whether it will do the job. Interference to flow through the cooler cannot be tolerated, but increased velocity will be beneficial. Can we operate this setup automatically?—PCJ

Piping Depends On Several Factors

YES, THE PUMP can be used as PCJ suggests but piping layout depends on whether (1) overhead tank can be connected to house line, (2) house demand is sufficient to keep pump running continuously and (3) demand permits operating the pump automatically.

I suggest that the pump be connected ahead of the cooler and the cooler discharge, fitted with an automatically controlled sewer branch, be piped directly to overhead tank.

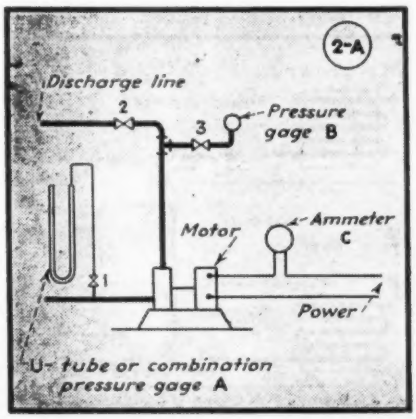
House supply then comes from overhead tank until the pressure falls below that in city mains. A check valve in the city line then opens to supply water to the building and cooler.

Kearny, N. J. GEORGE MCNALLY

Check Pressure of Pump Suction

ONLY WAY for PCJ to determine whether his pump is suitable for the job is to make a test, sketch 2-A. With the motor at rest, close valves 1, 2, and 3 and turn on water supply to the cooler. Vent the entrapped air and fill the pump-suction line with water, using either valve 2 or priming cocks on the pump. Reclose valve 2 and start pump-driving motor. Open valve 3.

If gage *B* indicates less than 25 psi, pump is not suitable for the job. If it indicates more than 25 psi, open valve 2 until gage *B* indicates 25 psi or until the valve is full open. With valve 2



adjusted as described, open valve 1 and observe the pressure in pump suction line. If it is positive, the pump is restricting flow through the cooler. If suction pressure is negative the pump tends to increase flow through the cooler. Observe motor current on the ammeter *C* to determine if motor is overloaded. The discharge pressure of 25 psi makes adequate allowance for pipe-friction loss and assures delivery of water to the storage tank 40 ft above the pump.

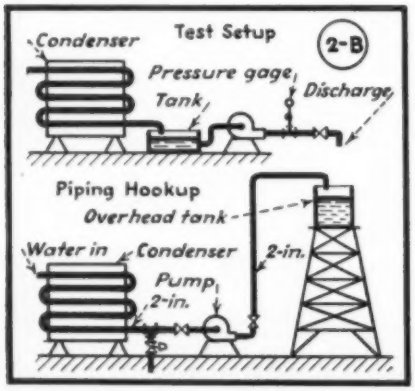
To operate this setup automatically, install a check valve in the pump discharge line and connect the pump motor to power line that feeds equipment which the cooler serves. Then when the equipment is started the pump will start and operate automatically. In the event that remaining equipment is steam driven, the only manual operation necessary will be closing and opening the motor switch.

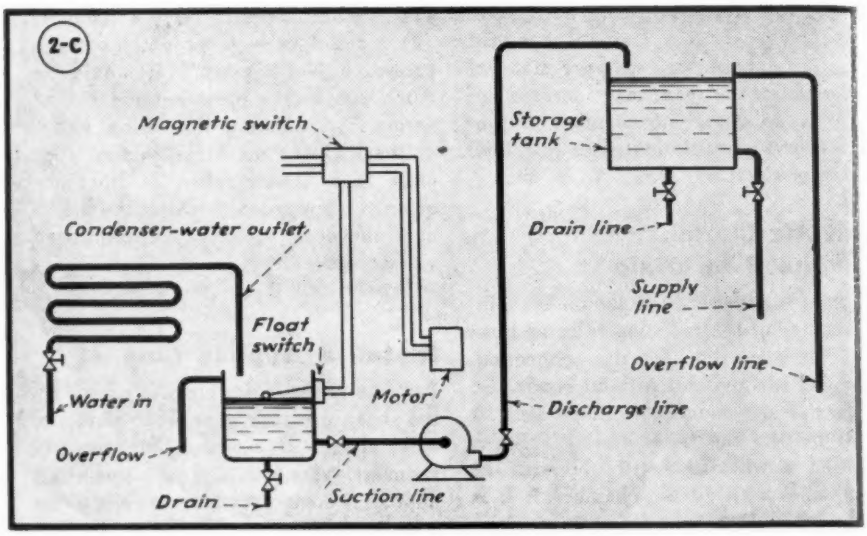
HAZLETON, PA. R H SWOYER

Use Solenoid Bypass

TEST SETUP in sketch 2-B shows how to test the pump for the job. The discharge should be throttled to the point where the pump is handling all the water coming from the cooler. If the pressure gage between pump discharge and throttling valve shows a pressure of 25 psi (gage) or more without overloading the motor, the pump has enough capacity and is in condition to do the job.

Pipe the cooler discharge to the pump suction so that any remaining pressure in the main supply line can be thus efficiently utilized. The tee connection is provided so that if the pump is not in use, discharge from the cooler can be run to the sewer. The system can be made automatic by using a solenoid-operated valve on the sewer branch. Connect the coil across the motor line so that when the motor is started valve closes and the pump then delivers water to the overhead tank.





It will probably be necessary to use a valve on the discharge to regulate the amount of flow through the cooler as the pump may handle more water than now goes through the cooler.

If the piping between tank and pump is short and direct a 2-in. pipe will probably be large enough. If the run is long with numerous bends and fittings a 2½-in. line will be necessary to reduce friction drop.

Brooklyn, N. Y. JOHN SALVIANI

Install Float Switch In Overhead Tank

WITH A 2-IN. SUCTION it is not likely that the pump is designed to pump over 275 gpm, and at that flow, with a 5-hp motor, the head would be about 45 ft. This is hardly enough excess pressure to overcome friction loss in the piping.

Relation between impeller diameter and head it will produce is indicated thus

$$h = \frac{(\text{rpm} \times d)^2}{3{,}390{,}000}$$

where

d = diameter of impeller, in.
h = head developed by pump, ft
rpm = speed of pump

If impeller diameter is 8 in., head developed will be 55.8 ft.

Discharge from the cooler can be connected directly to the pump suction with a solenoid-valve-controlled branch line discharging into the sewer. Also provide the overhead tank with a float switch, connected to both motor and electrically operated valve. When the water recedes to a predetermined level in the overhead tank, the float switch energizes the motor and closes the sewer valve.

Kalamazoo, Mich. E E NORMAN

Check Head Pressure of the Pump

FROM INFORMATION SUBMITTED by PCJ it is evident that this pump was designed for greater head pressure than he requires. Whether the pump is in good condition can be easily ascertained with a homemade setup comprising two oil barrels, a pressure gage and a valve connected on the pump discharge to enable PCJ to plot a head capacity graph. An automatically controlled hookup is simple and sketch 2-C is self-explanatory.

CARL BACHMANN
Glenwood Springs, Colo.

Suggests Smaller Impeller

THE PUMP probably has a 1½-in. discharge and will handle 60 to 75 gpm against a 150-ft head with a 5-hp motor. At 40-ft head the motor would handle about 350 gpm, but the pump could not handle it.

At 15 psi there would be a flow of 20 to 30 gpm through the cooler. This can be increased materially by using the pump, but even then it might be advisable to put a slower motor on the pump or to turn down the impeller for a lower head.

I suggest that the pump be installed ahead of the cooler and the discharge piped to the elevated tank. Combination of head through the cooler and head to the tank might work out nicely for the pump, and if too much water is forced through the system the impeller can then be reduced in diameter and a nice balance obtained. The system can be made automatic, either to start and stop with the compressor motor or by a temperature or pressure relay.

Carlsbad, N. M. E A ROBERTS

Make Field Test

IF PUMP PERFORMANCE CURVES cannot be obtained make a field test to determine head-flow characteristic and power requirements. Sketch 2-D shows one simple method. A stop watch times the filling of calibrated barrel. Start with pump running by swinging pipe over at each new flow rate from shutoff to full flow. Plot test results as shown. From details of the proposed line to overhead tank, system head can be calculated and plotted. Intersection of head curves indicates the maximum flow possible.

Head (ft) at each flow rate =

$$P_2 - P_1 + \frac{V_2^2 - V_1^2}{2g}$$

Where V_1 and V_2 are velocities in ft per sec and g is acceleration of gravity. Run two tests at each flow rate from shutoff to wide open and plot total head against flow. Gage readings in psi times 2.31 equal head in ft. Head at zero flow (point A) =

$$\frac{U^2}{2g}$$

where:

$$U \text{ equals } \frac{\pi \times D \times \text{rpm}}{12 \times 60}$$

D = impeller diameter in inches.

If no electrical meters are available determine power input from formula: hp = 8.33 × gpm × total head divided by 33,000 × 0.6 if pump has a closed impeller and gpm and head are taken from the graph. If impeller is open, substitute 0.3 instead of 0.6.

If a field test cannot be made, calculate head at no flow approximately from impeller diameter and speed. Impeller type and design determine shape of head curve.

If cooler outlet does not have to be visible and cooler and pump casing can safely stand the extra pressure installation can be made as indicated to give automatic control. Flow rate is set by adjusting the discharge gate valve. Otherwise sump service with a float switch and priming equipment for on-off control is indicated. The conditions with 15 psi at pump inlet and added resistance of cooler to system head curve give a new operating point as indicated by dotted lines on the graph. Flow rates below this maximum are obtained by throttling the pump discharge.

St. John, N. B. C G CLARK

Determine the Cooler Discharge

FLOW THROUGH COOLER should first be determined by running discharge from the coils into a tank or barrel. Then record filling time.

To test the pump equip the discharge with a pressure gage and a suitable valve for throttling. The suction should be connected to the 15-psi water pipe and the discharge should be piped so that the same tank used for measuring cooler flow can be used.

Operate at normal speed and determine shutoff pressure. This must exceed 35 psi. If in excess of 35 psi, open the discharge valve until this pressure is obtained, then push measuring tank under discharge. Tank should fill as rapidly as when testing flow from cooler.

If pump is not operating at its designed head in this setup, the resulting efficiency will be impaired. Difference in power costs will probably pay for a pump designed to fit the conditions.

Hamilton, Ont. J A COULDEN

Operate Pump Intermittently

ASSUME THAT TOTAL FLOW through the cooler is 50 gpm. To raise this water through a 50-ft total head at an efficiency of 50% would require approximately 1.26 hp. It is evident that the power required to handle the load is considerably under motor capacity.

Not having the pump characteristics, PCJ can ascertain its delivery and head by connecting it up with a supply and installing a valve and pressure gage on the discharge. To get reasonable efficiency from the unit install a tank between the pump and coils, with a float control, so that pump may be operated intermittently at near its rated capacity; otherwise it will be necessary to throttle the discharge materially. Locate the pump so that its suction is under positive head and place regulating valves only in the discharge line.

Oak Ridge, Tenn. I A BUTCHER

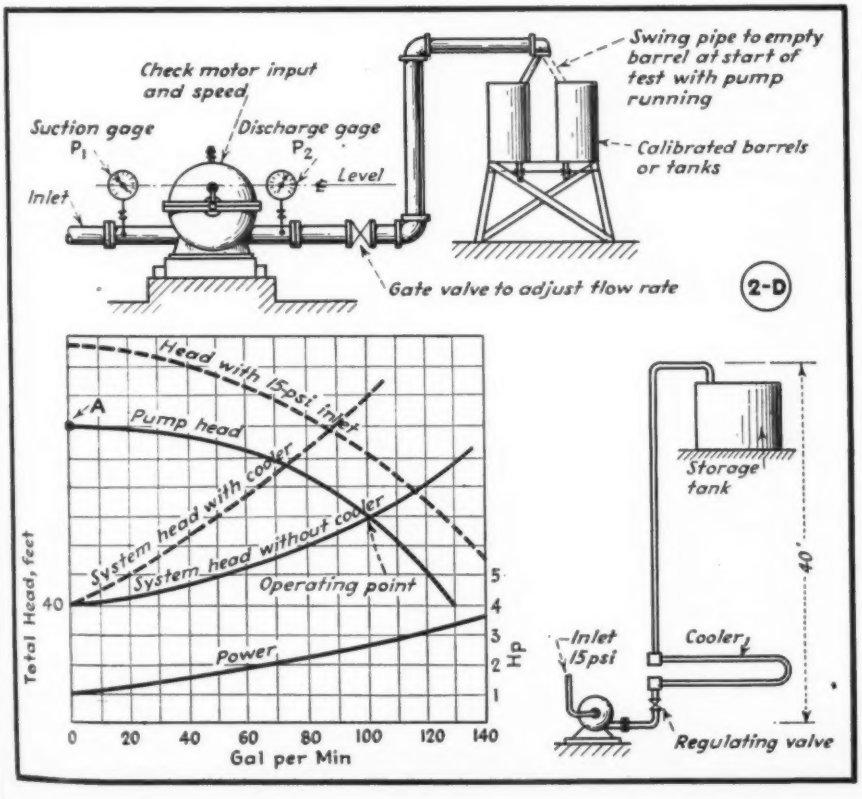
Use Float for On-and-Off Operation

BEST WAY for PCJ to test his pump is to connect it to a water source with the same characteristics it is to operate under. Connect a water meter, pressure gage and valve in the discharge line. Calculate the total dynamic head that pump must work against and convert it to psi pressure.

Start the pump with discharge valve shut, read the water meter, record the time and open the discharge valve until pressure gage indicates total discharge pressure computed. At the end of an hour subtract the meter difference and divide by 60 to get gpm. If a water meter is not available, discharge into a tank of known capacity.

If the pump connects direct to the cooler it must run continuously, but if the cooler discharges into a sump, pump motor can be float-controlled.

Baltimore, Md. C W PARKS



Q&A

By ALEX HIGGINS

QUESTIONS & ANSWERS FOR POWER ENGINEERS

22—*How to Use Steam Tables*

Twenty-second in a series that is running in every number of* POWER. *From long experience as a professional and practical engineer, Alex Higgins, of Calgary, Alberta, Canada, asks and answers questions regarding power equipment.

Q 1—*What is steam?*

A—Steam is water in a semi-gaseous condition. Though it obeys to some extent the simple laws governing the behavior of true gases, it is a *vapor* rather than a gas, that is, a substance between the purely liquid and gaseous forms.

Q 2—*Explain how steam is generated from water in a steam boiler.*

A—Furnace heat is conducted through the metal of plates and tubes, heating water directly in contact with the metal. This heated water, being now lighter than the colder water above, rises and the colder water flows downward to take its place. By the convection currents thus set up, the whole mass of water is gradually heated to the boiling point, when further addition of heat changes it into steam. There is no change of weight in the process; one pound of water changes into one pound of steam.

Q 3—*Upon what does the boiling point of water depend?*

A—It depends upon the pressure exerted on the water. At sea level the boiling point of water under atmospheric pressure (14.7 psi abs) is 212 F. As pressure decreases, the boiling point decreases and, as pressure increases, the boiling point increases. Thus at 10 psi abs, the boiling point is 193.21 F. At 20 psi abs, the boiling point is 227.96 F.

Q 4—*In connection with the generation of steam, what is meant by sensible heat?*

A—It is heat added to water to bring it from 32 F to boiling point. Temperature rise can be measured on a thermometer and felt by the physical senses. Hence the name, *sensible* heat.

Q 5—*What is the latent heat of steam?*

A—This is the amount of heat required to convert water at the boiling point into steam at the same temperature and pressure. The word *latent* means hidden and is applied here because there is no indication of the effect of adding heat other than the change in state from a liquid to a vapor.

Q 6—*What is the total heat of steam?*

A—This is the sum of the sensible heat and latent heat. The latest steam tables use the word *enthalpy* to replace heat in the expressions just defined. Thus sensible heat becomes *enthalpy of the liquid*, latent heat becomes *enthalpy of evaporation* and total heat, *enthalpy of steam*. Water or steam at the boiling point is said to be saturated. Table I on the next page uses the abbreviation "Sat liquid" for heat of liquid or sensible heat, "Evap" for latent heat, and "Sat vapor" for total heat, all under the general heading enthalpy.

Q 7—*What is saturated steam?*

A—It is steam as it is generated from water, just barely on the steam side of the fence, so to speak. Any loss of heat without a corresponding drop in pressure immediately starts to condense it back into water.

Q 8—*What is dry saturated steam?*

A—If the saturated steam, as generated from water, contains no moisture in suspension (that is, no fine drops of liquid water as in fog) it is said to be dry. If it contains moisture it is called wet steam. Completely dry steam is invisible. The white, foggy appearance of most steam discharged to atmosphere is caused by particles of liquid water in suspension.

Q 9—*What is meant by quality of steam?*

A—The term quality refers indirectly to the amount of water or unevaporated moisture in steam. If it is perfectly dry, its quality will be 100%, but if it contains, say 2% of moisture, its quality will be 100 − 2 = 98%.

Q 10—*How is the quality of steam determined?*

A—It is determined by means of an apparatus called a *calorimeter*. There are three types: the barrel calorimeter, a primitive type and not very accurate; the throttling calorimeter, which determines percentages up to about 7% at 400 psi gage, and the separating calorimeter which has a wider range and is as a rule more accurate than the first two. (See Q 28.)

Q 11—*What is superheated steam and why is steam superheated?*

A—It is steam at a temperature higher than the saturation temperature for the given pressure. Steam is superheated by passing saturated steam through tube coils exposed to furnace heat. Steam thus raised in temperature, or superheated, will have to drop in temperature by the amount of its superheat before it begins to condense. This is of considerable benefit in power plant operation as it allows for radiation loss of heat in steam piping, lessens danger of damage from water hammer in pipelines and engine cylinders, improves thermal efficiency of engines and turbines and reduces the bad effects of excessive moisture in the low-pressure stages of steam turbines.

Q 12—*What are saturated steam tables?*

A—They are tabulated values of various properties of saturated steam such as boiling point (saturation temperature), specific volume (volume of 1 lb in cu ft), sensible heat (enthalpy of saturated liquid), latent heat (enthalpy of evaporation) and total heat (enthalpy of saturated vapor or of superheated vapor), calculated for a wide range of pressures. Absolute pressures are used in steam tables be-

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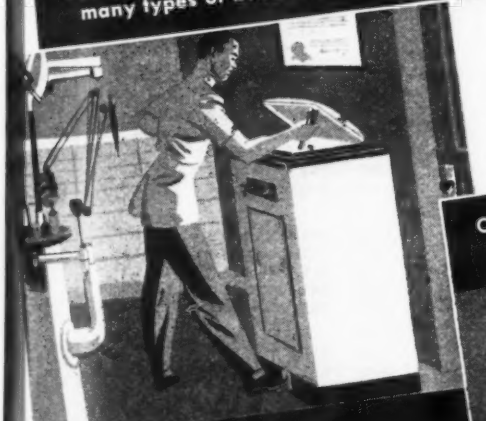

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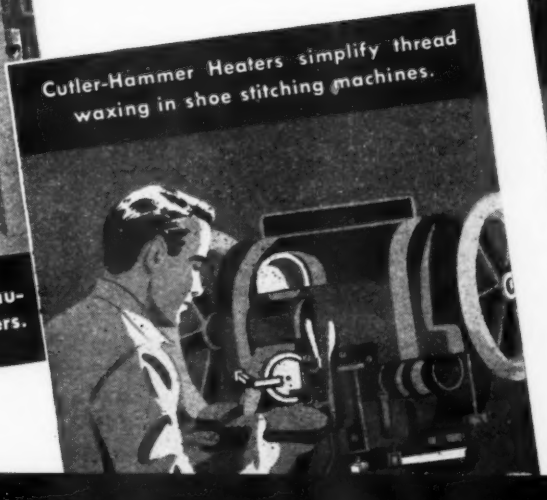

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Cutler-Hammer Heaters keep incubator at a safe, even temperature.

Q&A FOR POWER ENGINEERS

(*Continued from page* 118)

cause gage pressures are based on atmospheric pressure, which varies with altitude and weather conditions. *All quantities in Tables I and II refer to one pound of water or dry and saturated steam.* Temperatures are in degrees Fahrenheit. Enthalpy is in Btu. Enthalpy of the liquid or of steam is the amount of heat required to produce the given water or steam, starting with water at 32 F.

At atmospheric pressure (14.7 psi abs) enthalpy of the saturated liquid is 212 − 32 = 180 Btu or temperature of the water less 32 degrees.

Q 13—*What does a study of steam tables show?*

A—The tables show that each pressure has a corresponding boiling point and, as the pressure rises:

a. boiling-point temperature rises also
b. sensible heat increases
c. latent heat decreases
d. total heat increases slowly until pressure is approximately 450 psi abs; then decreases slowly until pressure approaches the so-called critical point, about 3200 psi).

Q 14—*What would be the effect of a sudden rise or a sudden drop in pressure in a closed vessel containing steam if there were no temperature change?*

A—Pressure rise without a corresponding temperature rise would cause some of the steam to condense, as the temperature would then be below the boiling point corresponding to the pressure. A drop in pressure would cause the steam to become superheated because its temperature would then be above the boiling point temperature corresponding to the pressure.

If the pressure drop takes place in a boiler where the steam is in contact with the water from which it is generated, some of the water will evaporate into steam because of the lowered boiling point. If the lowering of pressure is brought about very suddenly by the rupture of some part of the boiler much of the water in the boiler may instantly flash into steam, causing a disastrous explosion. As one pound of steam at atmospheric pressure occupies about 1600 times the space occupied by one pound of water, the explosive energy released by such a sudden pressure drop would be tremendous.

Q 15—*Compare the use of steam for power and for heating purposes.*

A—An examination of Tables I and II shows that the greater part of the total heat necessary to convert water into steam is used up, not in raising temperature but in changing the boiling liquid into a vapor, and this latent heat is not given back by the steam unless it is condensed into water.

In a *heating system*, the steam condenses into water in the radiators or heating coils, and in doing so gives up its latent heat. Thus the greater part of the heat in steam does useful work when steam is used for heating purposes, and the system therefore has a high efficiency.

In a *power plant*, where steam is used for power purposes, the engine exhaust is still in the form of steam, and contains the greater part of the original quantity of heat in the steam.

Q 16—*What is the critical temperature and pressure of steam?*

A—If steam is generated under conditions where pressures do not exceed several hundred pounds per square inch and the pressure could be suddenly raised a few pounds without a corresponding rise in temperature, some of the steam would be condensed or liquefied because the boiling temperature would now be higher. If however, the pressure were allowed to rise to 3206.2 psi abs, with a corresponding tempera-

TABLE I—PROPERTIES OF SATURATED STEAM

Abs press	Temp	Specific vol		Enthalpy		
Psi	F	Sat liquid	Sat vapor	Sat liquid	Evap	Sat vapor
0.50	79.58	0.01608	641.4	47.6	1048.8	1096.4
1.0	101.74	0.01614	333.6	69.7	1036.3	1106.0
2.0	126.08	0.01623	173.73	94.0	1022.2	1116.2
3.0	141.48	0.01630	118.71	109.4	1013.2	1122.6
4.0	152.97	0.01636	90.63	120.9	1006.4	1127.3
5.0	162.24	0.01640	73.52	130.1	1001.0	1131.1
6.0	170.06	0.01645	61.98	138.0	996.2	1134.2
7.0	176.85	0.01649	53.64	144.8	992.1	1136.9
8.0	182.86	0.01653	47.34	150.8	988.5	1139.3
9.0	188.28	0.01656	42.40	156.2	985.2	1141.4
10	193.21	0.01659	38.42	161.2	982.1	1143.3
14.7	212.00	0.01672	26.80	180.0	970.4	1150.4
15	213.03	0.01672	26.29	181.1	969.7	1150.8
20	227.96	0.01683	20.089	196.2	960.1	1156.3
25	240.07	0.01692	16.303	208.5	952.1	1160.6
30	250.33	0.01701	13.746	218.8	945.3	1164.1
40	267.25	0.01715	10.498	236.0	933.7	1169.7
50	281.01	0.01727	8.515	250.1	924.0	1174.1
60	292.71	0.01738	7.175	262.1	915.5	1177.6
70	302.92	0.01748	6.206	272.6	907.9	1180.6
80	312.03	0.01757	5.472	282.0	901.1	1183.1
90	320.27	0.01766	4.896	290.6	894.7	1185.3
100	327.81	0.01774	4.432	298.4	888.8	1187.2
110	334.77	0.01782	4.049	305.7	883.2	1188.9
120	341.25	0.01789	3.728	312.4	877.9	1190.4
130	347.32	0.01796	3.455	318.8	872.9	1191.7
140	353.02	0.01802	3.220	324.8	868.2	1193.0
150	358.42	0.01809	3.015	330.5	863.6	1194.1
160	363.53	0.01815	2.834	335.9	859.2	1195.1
170	368.41	0.01822	2.675	341.1	854.9	1196.0
180	373.06	0.01827	2.532	346.1	850.8	1196.9
190	377.51	0.01833	2.404	350.8	846.8	1197.6
200	381.79	0.01839	2.288	355.4	843.0	1198.4
250	400.95	0.01865	1.8438	376.0	825.1	1201.1
300	417.33	0.01890	1.5433	393.8	809.0	1202.8
350	431.72	0.01913	1.3260	409.7	794.2	1203.9
400	444.59	0.0193	1.1613	424.0	780.5	1204.5
450	456.28	0.0195	1.0320	437.2	767.4	1204.6
500	467.01	0.0197	0.9278	449.4	755.0	1204.4
600	486.21	0.0201	0.7698	471.6	731.6	1203.2
700	503.10	0.0205	0.6554	491.5	709.7	1201.2
800	518.23	0.0209	0.5687	509.7	688.9	1198.6
900	531.98	0.0212	0.5006	526.6	668.8	1195.4
1000	544.61	0.0216	0.4456	542.4	649.4	1191.8
1100	556.31	0.0220	0.4001	557.4	630.4	1187.8
1200	567.22	0.0223	0.3619	571.7	611.7	1183.4
1300	577.46	0.0227	0.3293	585.4	593.2	1178.6
1400	587.10	0.0231	0.3012	598.7	574.7	1173.4
1500	596.23	0.0235	0.2765	611.6	556.3	1167.9
2000	635.82	0.0257	0.1878	671.7	463.4	1135.1
2500	668.13	0.0287	0.1307	730.6	360.5	1091.1
3000	695.36	0.0346	0.0858	802.5	217.8	1020.3
3206.2	705.40	0.0503	0.0503	902.7	0	902.7

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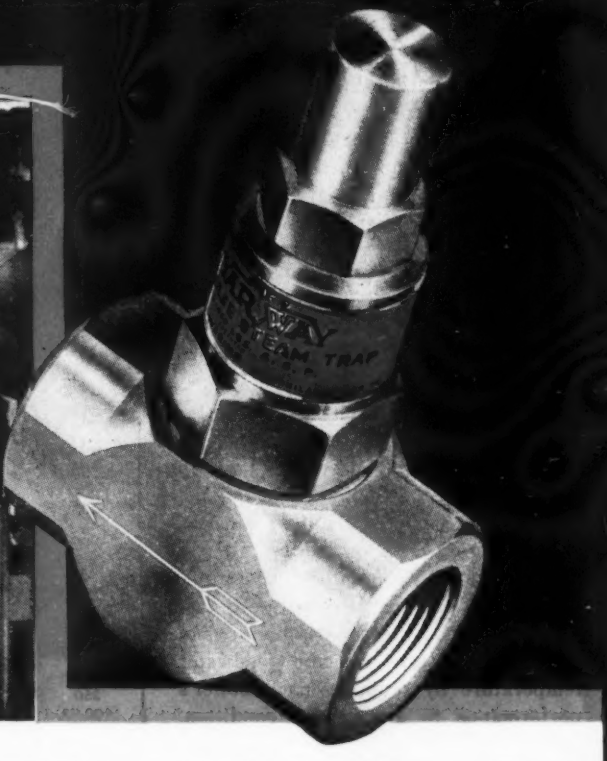

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YARWAY IMPULSE STEAM TRAP

Q&A FOR POWER ENGINEERS

(*Continued from page* 120)

ture of 706 F, no additional amount of pressure would cause the steam to condense. At this point the density of water and steam is the *same*, and latent heat of evaporation disappears entirely. Hence, if water under a pressure of 3206.2 psi abs is heated to 706 F it changes into steam there without further application of heat. These two values, 3206.2 psi abs and 706 F, are known as the *critical pressure* and *critical temperature* of steam. It is impossible for water to exist as a liquid at any temperature above 706 F.

Q 17—*What is equivalent evaporation?*

A—All boilers do not work under the same conditions of pressure and feedwater temperature, so actual weight of water evaporated per hour or per pound of coal fired is not a fair way of comparing various boilers, unless pressure and temperature conditions are exactly alike. However, we can form a basis of comparison for any conditions of pressure and feedwater temperature by reducing each boiler's performance to a standard condition. One such condition is *the amount of water in pounds that would be evaporated from water at 212 F into steam at 212 F and 14.7 psi abs by the heat put into the steam actually evaporated in 1 hr by 1 lb of fuel.* This amount is known as equivalent evaporation, from and at 212 F per pound of fuel.

Amount of heat to evaporate 1 lb of water from and at 212 F is 970.4 Btu. If we divide total heat put into the steam generated per hour, or per pound of fuel by 970.4 we get the equivalent evaporation from and at 212 F per hour, or per pound, as the case may be.

Q 18—*Boiler takes feedwater at* 175 *F. Working steam pressure is* 140 *psi abs. Water evaporated per lb fuel burned is* 6.8 *lb. What is equivalent evaporation?*

A—Let H = total heat to evaporate 1 lb steam under these conditions
h = 1193.0 Btu (total heat in 1 lb steam at 140 psi abs)
t = 175 F (from question)
Then $H = h - (t - 32)$ =
1193.0 − (175 − 32) = 1050.0 Btu
Total heat per lb fuel burned =
1050.0x6.8 = 7140 Btu
Equivalent evaporation = 7140 ÷ 970.4 = 7.36 lb water per lb fuel burned. *Ans.*

Q 19—*What is factor of evaporation?*

TABLE II—PROPERTIES OF SUPERHEATED STEAM

Abs Press Psi (Sat temp)	*	Sat liquid	Sat vapor	Temperature, degrees F 300	400	500	600	700	800	900	1000
15	v	0.02	26.29	29.91	33.97	37.99	41.99	45.98	49.97	53.95	57.93
(213.03)	h	181.1	1150.8	1192.8	1239.9	1287.1	1334.8	1383.1	1432.3	1482.3	1533.1
	s	0.3135	1.7549	1.8136	1.8719	1.9238	1.9711	2.0147	2.0554	2.0936	2.1296
20	v	0.02	20.09	22.36	25.43	28.46	31.47	34.47	37.46	40.45	43.44
(227.96)	h	196.2	1156.3	1191.6	1239.2	1286.6	1334.4	1382.9	1432.1	1482.1	1533.0
	s	0.3356	1.7319	1.7808	1.8396	1.8918	1.9392	1.9829	2.0235	2.0618	2.0978
40	v	0.017	10.498	11.040	12.628	14.168	15.688	17.198	18.702	20.20	21.70
(267.25)	h	236.0	1169.7	1186.8	1236.5	1284.8	1333.1	1381.9	1431.3	1481.4	1532.4
	s	0.3919	1.6763	1.6994	1.7608	1.8140	1.8619	1.9058	1.9467	1.9850	2.0212
60	v	0.017	7.175	7.259	8.357	9.403	10.427	11.441	12.449	13.452	14.454
(292.71)	h	262.1	1177.6	1181.6	1233.6	1283.0	1331.8	1380.9	1430.5	1480.8	1531.9
	s	0.4270	1.6438	1.6492	1.7135	1.7678	1.8162	1.8605	1.9015	1.9400	1.9762
80	v	0.018	5.472	.....	6.220	7.020	7.797	8.562	9.322	10.077	10.830
(312.03)	h	282.0	1183.1	.....	1230.7	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3
	s	0.4531	1.6207	.....	1.6791	1.7346	1.7836	1.8281	1.8694	1.9079	1.9442
100	v	0.018	4.432	.....	4.937	5.589	6.218	6.835	7.446	8.052	8.656
(327.81)	h	298.4	1187.2	.....	1227.6	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8
	s	0.4740	1.6026	.....	1.6518	1.7085	1.7581	1.8029	1.8443	1.8829	1.9193
120	v	0.018	3.728	.....	4.081	4.636	5.165	5.683	6.195	6.702	7.207
(341.25)	h	312.4	1190.4	.....	1224.4	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2
	s	0.4916	1.5878	.....	1.6287	1.6869	1.7370	1.7822	1.8237	1.8625	1.8990
140	v	0.018	3.220	.....	3.468	3.954	4.413	4.861	5.301	5.738	6.172
(353.02)	h	324.8	1193.0	.....	1221.1	1275.2	1326.4	1376.8	1427.3	1478.2	1529.7
	s	0.5069	1.5751	.....	1.6087	1.6683	1.7190	1.7645	1.8063	1.8451	1.8817
160	v	0.018	2.834	.....	3.008	3.443	3.849	4.244	4.631	5.015	5.396
(363.53)	h	335.9	1195.1	.....	1217.6	1273.1	1325.0	1375.7	1426.4	1477.5	1529.1
	s	0.5204	1.5650	.....	1.5908	1.6519	1.7033	1.7491	1.7911	1.8301	1.8667
180	v	0.018	2.532	.....	2.649	3.044	3.411	3.764	4.110	4.452	4.792
(373.06)	h	346.0	1196.9	.....	1214.0	1271.0	1323.5	1374.7	1425.6	1476.8	1528.5
	s	0.5325	1.5542	.....	1.5745	1.6373	1.6894	1.7355	1.7776	1.8167	1.8534
200	v	0.018	2.288	.....	2.361	2.726	3.060	3.380	3.693	4.002	4.309
(381.79)	h	355.4	1198.4	.....	1210.3	1268.9	1322.1	1373.6	1424.8	1476.2	1528.0
	s	0.5435	1.5453	.....	1.5594	1.6240	1.6767	1.7232	1.7655	1.8048	1.8415
250	v	0.0187	1.8438	.....	.....	2.151	2.427	2.688	2.942	3.192	3.439
(400.95)	h	376.0	1201.1	.....	.....	1263.4	1318.5	1371.0	1422.7	1474.5	1526.6
	s	0.5675	1.5263	.....	.....	1.5949	1.6495	1.6969	1.7397	1.7793	1.8162
300	v	0.0189	1.5433	.....	.....	1.7675	2.005	2.227	2.442	2.652	2.859
(417.33)	h	393.8	1202.8	.....	.....	1257.6	1314.7	1368.3	1420.6	1472.8	1525.2
	s	0.5879	1.5104	.....	.....	1.5701	1.6268	1.6751	1.7184	1.7582	1.7954
400	v	0.0193	1.1613	.....	.....	1.2851	1.4770	1.6508	1.8161	1.9767	2.134
(444.59)	h	424.0	1204.5	.....	.....	1245.1	1306.9	1362.7	1416.4	1469.4	1522.4
	s	0.6214	1.4844	.....	.....	1.5281	1.5894	1.6398	1.6842	1.7247	1.7623
500	v	0.0197	0.9278	.....	.....	0.9927	1.1591	1.3044	1.4405	1.5715	1.6998
(467.01)	h	449.4	1204.4	.....	.....	1231.3	1298.6	1357.0	1412.1	1466.0	1519.6
	s	0.6487	1.4634	.....	.....	1.4919	1.5588	1.6115	1.6571	1.6982	1.7363
600	v	0.0201	0.7698	.....	.....	0.7947	0.9463	1.0732	1.1899	1.3013	1.4096
(486.21)	h	471.6	1203.2	.....	.....	1215.7	1289.9	1351.1	1407.7	1462.5	1516.7
	s	0.6720	1.4454	.....	.....	1.4586	1.5323	1.5875	1.6343	1.6762	1.7147
800	v	0.0209	0.5687	.....	.....	.....	0.6779	0.7833	0.8763	0.9633	1.0470
(518.23)	h	509.7	1198.6	.....	.....	.....	1270.7	1338.6	1398.6	1455.4	1511.0
	s	0.7108	1.4153	.....	.....	.....	1.4863	1.5476	1.5972	1.6407	1.6801
1000	v	0.0216	0.4456	.....	.....	.....	0.5140	0.6084	0.6878	0.7604	0.8294
(544.61)	h	542.4	1191.8	.....	.....	.....	1248.8	1325.3	1389.2	1448.2	1505.1
	s	0.7430	1.3897	.....	.....	.....	1.4450	1.5141	1.5670	1.6121	1.6525
1200	v	0.0223	0.3619	.....	.....	.....	0.4016	0.4909	0.5617	0.6250	0.6843
(567.22)	h	571.7	1183.4	.....	.....	.....	1223.5	1311.0	1379.3	1440.7	1499.2
	s	0.7711	1.3667	.....	.....	.....	1.4052	1.4843	1.5409	1.5879	1.6293
1400	v	0.0231	0.3012	.....	.....	.....	0.3174	0.4062	0.4714	0.5281	0.5805
(587.10)	h	598.7	1173.4	.....	.....	.....	1193.0	1295.5	1369.1	1433.1	1493.2
	s	0.7963	1.3454	.....	.....	.....	1.3639	1.4567	1.5177	1.5666	1.6093
1500	v	0.0235	0.2765	.....	.....	.....	0.2815	0.3719	0.4352	0.4893	0.5390
(596.23)	h	611.6	1167.9	.....	.....	.....	1174.5	1287.2	1363.8	1429.3	1490.1
	s	0.8082	1.3351	.....	.....	.....	1.3412	1.4434	1.5068	1.5569	1.6001
2000	v	0.0257	0.1878	.....	.....	.....	.....	0.2489	0.3074	0.3532	0.3935
(635.82)	h	671.7	1135.1	.....	.....	.....	.....	1240.0	1335.5	1409.2	1474.5
	s	0.8619	1.2849	.....	.....	.....	.....	1.3783	1.4576	1.5139	1.5603
2500	v	0.0287	0.1307	.....	.....	.....	.....	0.1686	0.2294	0.2710	0.3061
(668.13)	h	730.6	1091.1	.....	.....	.....	.....	1176.8	1303.6	1387.8	1458.4
	s	0.9126	1.2322	.....	.....	.....	.....	1.3073	1.4127	1.4772	1.5273
3000	v	0.0346	0.0858	.....	.....	.....	.....	0.0984	0.1760	0.2159	0.2470
(695.36)	h	802.5	1020.3	.....	.....	.....	.....	1060.7	1267.2	1365.0	1441.8
	s	0.9731	1.1615	.....	.....	.....	.....	1.1966	1.3690	1.4439	1.4984
3206.2	v	0.0503	0.0503	.....	.....	.....	.....	.....	0.1583	0.1981	0.2288
(705.40)	h	902.7	902.7	.....	.....	.....	.....	.....	1250.5	1355.2	1434.7
	s	1.0580	1.0580	.....	.....	.....	.....	.....	1.3508	1.4309	1.4879

* v = *specific volume*; h = *enthalpy*; s = *entropy*

(Condensation reprinted by permission from "Thermodynamic Properties of Steam" by Keenan and Keyes, published by John Wiley & Sons, Inc)

SOLNUS OILS...

end carbon trouble, cut diesel shutdowns in half

An ice and cold storage plant in central Pennsylvania was all heated up about diesel oils. They had two diesels, both direct-connected to ammonia-compressors, and both driving generators by belt drive.

Heavy carbon deposits were sticking the rings and blocking exhaust ports and pipes. Twice a year the diesels had to shut down to have carbon scraped.

Three and a half years ago, a Sun Diesel engineer recommended the proper grade of Sun's Solnus oil for these engines. Since then rings, ports and pipes have been clean. Engines are shut down only once a year, and oil remains clear.

This is just one of the many current cases on file at Sun, which illustrate how the combination of Sun's engineering experience, plus Sun's proved line of diesel lubricants have saved money and eliminated headaches for operators.

Whatever equipment you operate . . . whether diesels, gas engines, gasoline engines, steam engines, turbines or electric motors . . . Sun's industrial products and "know-how" can help you.

SUN OIL COMPANY · *Philadelphia 3, Pa.*

Sponsors of the Sunoco News Voice of the Air — Lowell Thomas

SUNOCO

SUN INDUSTRIAL PRODUCTS

OILS FOR AMERICAN INDUSTRY

Q&A FOR POWER ENGINEERS

(*Continued from page* 122)

A—The equivalent evaporation that could be secured by the heat required to evaporate 1 lb steam at any given set of conditions is called the factor of evaporation for those particular conditions. Thus, in the previous question, the heat to evaporate 1 lb water into steam was 1050.0 Btu (from feedwater at 175 F into steam at 140 psi abs). In that case,

Factor of evaporation =

$$\frac{1050.0}{970.4} = 1.082 \; Ans.$$

Factors of evaporation for various feedwater and steam-pressure conditions are given in Table III, this page. Other factors can readily be calculated from Tables I and II.

Q 20—*What is a desuperheater and when is it used?*

A—A desuperheater is an apparatus that brings superheated steam back to the saturated state by adding sufficient moisture to reduce its temperature to that corresponding to the temperature of dry and saturated steam at that particular pressure. It is used where all boilers are supplying superheated steam to a main header and it is desired to secure a supply of saturated steam from the header for some purpose.

Fig. 1 shows the principle of one type of desuperheater. It is inserted in the superheated steam line as shown and water is sprayed in the path of the flowing superheated steam to change it to the saturated form. A thermostat is placed in the line on the saturated steam side of the desuperheater and it controls the water supply to the water sprays in the desuperheater. When the saturated steam temperature rises above that corresponding to its pressure as dry and saturated steam, part of the volatile liquid in the generator of the thermostat is evaporated, thus creating a pressure in the line connecting it to the sylphon bellows on the water-control valve. This pressure expands the bellows, causing it to open the water supply valve wider. When the temperature of the saturated steam falls below normal, liquid in the generator condenses, pressure in the connecting pipeline and sylphon bellows falls, the bellows contracts and partly closes the water valve.

Q 21—*How are steam boilers rated?*

A—Sometimes some nominal horsepower rating based on square feet of heating surface is adopted for license, certificate or other purposes, but because of differences in design and operating conditions, boilers with the same heating surface area may vary widely in evaporating capacity, which is the true measure of boiler power.

One method of rating boilers, based on actual performance, is the amount of water evaporated per square foot of heating surface per hour, reduced to equivalent evaporation. Another method takes heat output in steam expressed in Btu per hour. A third method, based on evaporation, takes *one boiler horsepower (actual output) as the evaporation of 34.5 lb water per hour, from water at a temperature of 212 F into steam at 212 F, and 14.7 psi abs.* To find the actual horsepower output by this last method, reduce actual evaporation in pounds of water per hour to equivalent evaporation and divide by 34.5. This boiler horsepower has no connection with engine horsepower (mechanical horsepower).

Q 22—*What is the developed horsepower output of a steam boiler working at 160 psi abs steam pressure and evaporating 3400 lb water per hour from feedwater at 140 F?*

A — Heat put into 1 lb steam at 160 psi abs, with feedwater at 140 F =
1195.1 − (140 − 32) = 1087.1 Btu
Equivalent evaporation =

$$\frac{3400 \times 1087.1}{970.4} = 3809 \text{ lb of water per hr}$$

Boiler hp = 3809 ÷ 34.5 = 110 hp *Ans.*

You shorten the work by using a table of factors of evaporation; thus the factor of evaporation here, from the table, is 1.12. Then

Equiv evap = 3400 × 1.12 = 3808
Boiler hp = 3808 ÷ 34.5 = 110 hp. *A.*

Q 23—*What information is required for a simple boiler efficiency test?*

A—This data must be secured:

1. Temperature of feedwater in deg F
2. Steam pressure in psi
3. Heat value of fuel used in Btu per lb
4. Pounds water evaporated during test
5. Pounds fuel burned during test
6. Duration of test

Q 24—*Find the efficiency of a steam boiler given the following data:*

Average feedwater temperature 160 F
Steam pressure 125 psi gage (approx 140 psi abs)
Heat value of fuel, 10,200 Btu per lb
Water evaporated in test, 36,000 lb
Coal fired, 6000 lb
Duration of test, 8 hours

A—Water evaporated per lb coal = 36,000 ÷ 6000 = 6 lb
Total heat put into 1 lb of steam
$= h - (t - 32)$
= 1193 − (160 − 32) = 1065 Btu
Total heat put into steam produced per lb of coal fired = 6x1065 = 6390 Btu

(*Continued on page* 140)

TABLE III—FACTORS OF EVAPORATION

Steam press in psi abs	Temperature of feedwater in degrees F						
	80	100	120	140	160	180	200
100	1.173	1.153	1.132	1.112	1.091	1.070	1.050
120	1.177	1.156	1.136	1.115	1.094	1.074	1.053
140	1.180	1.159	1.139	1.118	1.098	1.077	1.056
160	1.182	1.162	1.141	1.120	1.100	1.079	1.059
180	1.184	1.163	1.143	1.122	1.102	1.081	1.060
200	1.186	1.165	1.144	1.124	1.103	1.082	1.062

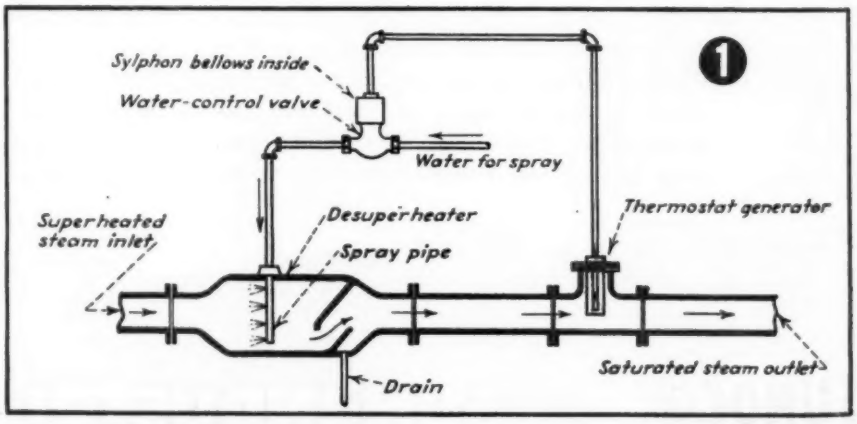


Fig. 1—This type of desuperheater uses a water spray to remove superheat

FACTS YOU SHOULD KNOW ABOUT THE STEEL VALVE

OUTLOOK FOR 1945

An annual report to steel valve users

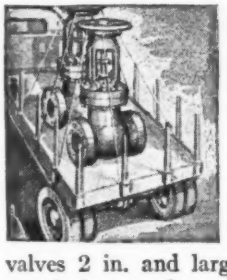
THERE'S good news in this annual report.

Throughout the entire war period, steel valves have been one of the most critical common components in American war production. As a consequence, though the industry's capacity has greatly expanded, the extremely high demands of Navy, Maritime Commission, 100-octane, synthetic rubber and other top-rated war programs have syphoned off the great bulk of steel valve production.

The 1945 outlook is more encouraging, however. Not only from the standpoint of deliveries, but also because it will bring the introduction of new products, new materials and new processes which are the result of the war-time development work of the steel valve industry engineering and laboratory staffs.

FIRST, ABOUT DELIVERIES

For the early months of the year, the smaller forged steel valves will continue to be rather tight. The smaller sizes will probably still be needed in large quantities for urgent war programs at least through the first quarter of 1945. The delivery outlook for most types of steel valves 2 in. and larger appears to be greatly improved.



You will find that if you do three things you can shorten deliveries of the steel valves you need:

1. Stick to standard valves. Continuing manpower shortages may make "specials" take about as long as they have the past few years.

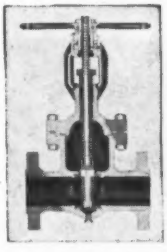
2. Use a substitute if you can. If the exact type of valve you want is oversold, check with your valve source to see if there isn't another valve available which will do just as well.

3. Check your order. Many delivery delays come from incomplete product description, service requirements or priority information on the order.

NEW DESIGNS, BETTER VALVES

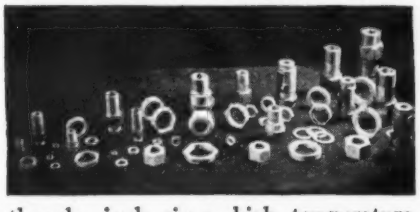
A lot of new refinements are being introduced to make your steel valves better valves.

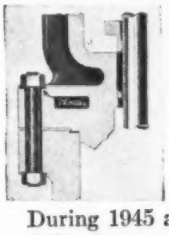
For instance, during the past year Edward has introduced, along with dozens of individual valve improvements, three major design advances:



1. A new, basically different gate valve, incorporating all six of the improvements operating men most wanted in their postwar gate valve. If you would like a complete description of this valve, write for Catalog 12-E.

2. EValizing, a new exclusively Edward plating process to add years of trouble-free life to valve parts most subject to abrasion and galling. Valve bonnet threads, junk rings, high temperature bonnet stud nuts and other Edward parts are now EValized as standard Edward manufacturing procedure.



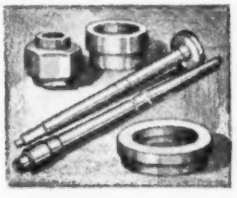


3. EVinlay, another life-lengthening Edward development for hard surfaced inlays on the high load bearing surfaces of high pressure and temperature valve parts.

During 1945 additional new products and developments, already well past the experimental stage, will be introduced. The steel valve industry faces many new problems since it is evident that substantial post-war expansion in many industrial fields calls for increasing temperatures and pressures. Steel valves will be needed in many processes and services where iron, brass or other materials were satisfactory before. Our laboratories, the most completely equipped laboratories devoted entirely to steel valve research in the country, have accumulated a great deal of significant data on the performance of various materials for many of the new manufacturing processes to be introduced in the post-war period. This development work has in no way interfered with our war production, however, for two more Gold Stars were added to our Maritime "M" pennant during 1944.

PARTS BUSINESS UP

Orders for steel valve repair parts are increasing as equipment continues to run long hours under heavy load. The Edward production department operates under the unvarying policy of giving parts orders preference, since we recognize that a part order usually represents an actual or expected operating interruption. Within the limitations of government regulation we will continue to emphasize prompt filling of repair part orders. It isn't, by the way, a very large portion of our business. Steel valves, in normal service, require relatively very few part replacements.



PROJECT PROBLEMS?

Possibly you have an expansion, reconversion or rebuilding program scheduled for the coming years. If you do and steel valves are involved, we'll be glad to consult with you on any problem that may arise. As the largest exclusive steel valve builder and a pioneer in the field, our development staff has had wide experience on boiler room, petroleum, industrial, technological and marine work. That experience is yours for the asking.

W. F. Crawford *President*

The Edward Valve & Mfg. Co., Inc.

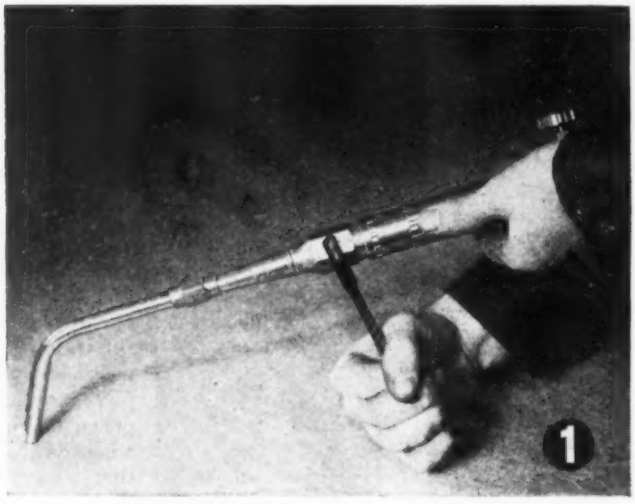
Building a complete line of steel valves for all land and marine service temperature and pressure conditions.

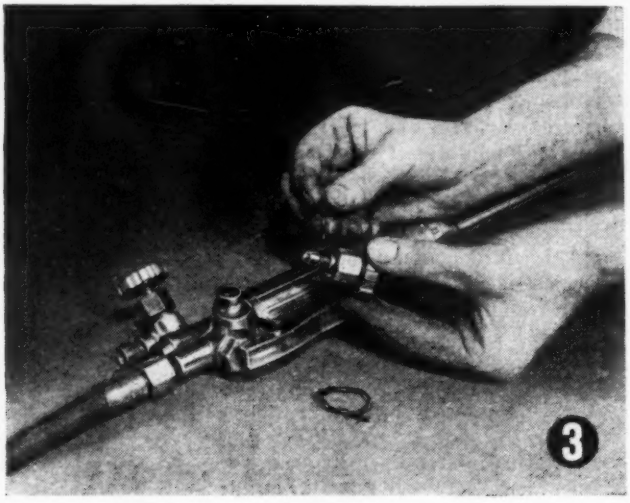
EAST CHICAGO INDIANA

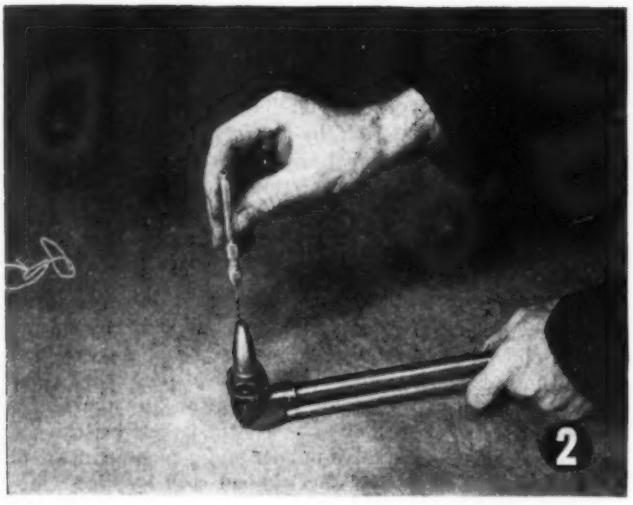
HOW TO PROLONG LIFE OF WELDING TORCHES

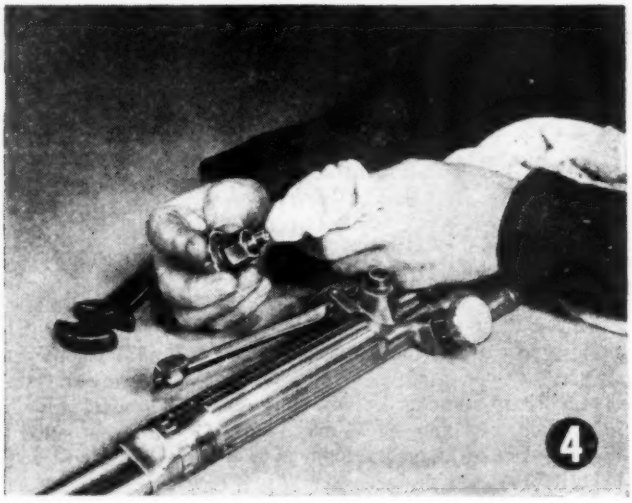
THESE SIMPLE RULES of care and maintenance will materially prolong the life of cutting and welding torches and keep them on the job. As with other mechanical devices inspect them at regular intervals and repair small defects before they damage the torch seriously.

When not in actual use disconnect the hose and put the torch in a special compartment reserved for it instead of on a workbench to be knocked around with other tools. Never leave a torch dangling from a gas cylinder because it may be knocked to the floor and seriously damaged. When changing tips or inspecting the torch always use the proper wrench—never use pliers or a Stillson wrench on the nuts. In contact with pure oxygen, oil may ignite and burn furiously so do not apply it. *Courtesy, The Linde Air Products Co*









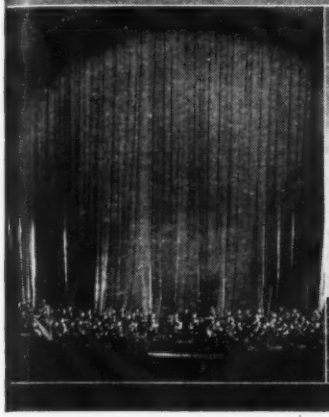
1 When changing heads, tips or extensions make sure that both seating surfaces are clean. A loose connection or piece of dirt on the tip seat may cause backfire or even flashback. Use only enough force to make a gas-tight fit because excessive force may ruin the seat or threads.

2 Holes in cutting nozzles and welding tips are carefully sized; enlarging them in any way affects torch performance. When removing foreign matter use the correct size drill or soft copper wire. Do not twist the drill; thrust it in and out. When possible remove the nozzle and insert cleaning object from the rear end.

3 If blowpipe gas-adjusting valves turn too easily thus allowing the flame to be continually knocked out of adjustment or if gas leaks past the loose valve stem, tighten the packing nut or install new packing in the gland. Attempts to tighten old hard packing may wreck the gland or nut threads.

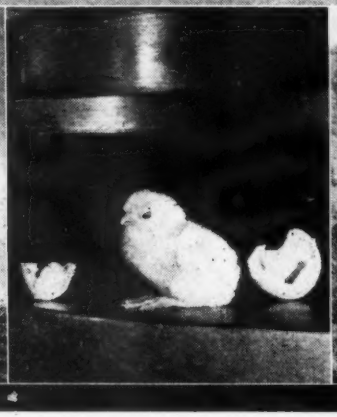
4 If needle valve does not shut off completely, remove the valve assembly and wipe seat and plug with a soft clean rag. If leak continues, grind the valve to a new seat or replace the worn parts with new ones. Always purchase replacements from original blowpipe manufacturer.

Would you believe it?

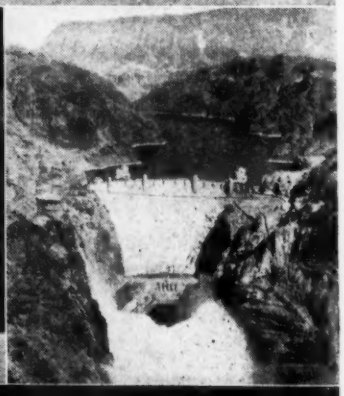


BALDWIN supplied the hydraulic elevators that raise and lower the stage of Radio City Music Hall.

BALDWIN diesel engines are used for main propulsion units on minesweepers and for auxiliary power on many other vessels.



BALDWIN testing machine of 3,000,000 pounds capacity can be controlled so as to break the shell of a hatching egg without harming the chick.



BALDWIN hydraulic turbines, 115,000 horsepower capacity, driving huge electric power generators, are installed at Boulder Dam.

Baldwin manufactures a wide diversity of products, including testing equipment for wind tunnels, steering gears for LST landing craft, hydraulic elevators for aircraft carriers, and many other machines and instruments, serving industry on which America is depending to speed final victory.

Of course, Baldwin is well known as the builder of locomotives of all types—steam, diesel-electric and electric—doing their share of the greatest transportation job in history.

BALDWIN

BLW THE BALDWIN GROUP

The Baldwin Locomotive Works, Philadelphia, Pennsylvania: Locomotive & Ordnance Division; Baldwin Southwark Division; Cramp Brass and Iron Foundries Division; Standard Steel Works Division; The Whitcomb Locomotive Co.; The Pelton Water Wheel Co.; The Midvale Co.

FOR THE ENGINEER'S BOOKSHELF

MANUAL OF MACHINE SHOP PRACTICE ..... *By Otis Benedict, Jr*
MATHEMATICS ..... *By John W Breneman*
THE OXY-ACETYLENE HANDBOOK ..... *Pub by The Linde Air Products Co*
CONVERSION FACTORS AND TABLES ..... *By O T Zimmerman and Irvin Lavine*
THERMODYNAMIC CHARTS ..... *By Frank O Ellenwood and Chas O Mackey*
PRODIGAL GENIUS: THE LIFE OF NIKOLA TESLA ..... *By John J O'Neill*
THE CANADA YEAR BOOK ..... *By Dominion Bureau of Statistics*
BOOKLETS ..... *Brief Reviews*

Machine Shop Practice

MANUAL OF MACHINE SHOP PRACTICE (1944) *By Otis Benedict, Jr, Assistant Professor, Dept of Shop Practice, Pratt Institute, School of Science and Technology, Brooklyn, N. Y. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y. 249 pages, illustrated, 5x7½, cloth.* $1.75.

Intended primarily for school use, this manual should be of interest to those practical engineers and maintenance men who may be a little rusty on figuring machine tool feeds, speeds, etc. Chapters cover chisels and files, cutting speeds, time for machining, screw threads, tapers, the spiral head, tolerances and allowances for machine parts, use of common precision measuring devices, press tools, typical standard die sets, machine tool analysis.

Thermodynamics

THERMODYNAMIC CHARTS (1939) (*Revised* 1944) *By Frank O Ellenwood and Charles O Mackey. Published by John Wiley & Sons Inc, 440 Fourth Ave, New York, N. Y. 46 pp, 8x11, 18 charts, 7 tables, cloth.* $2.75.

Most thermodynamic charts are either large and unhandy to use or too small to read with any degree of accuracy. The authors solve both these problems by breaking each chart into sections of full-page size so that they are easy to read and at the same time convenient to use.

Together with working examples the book contains steam, water, low-quality steam, ammonia, Freon-12 and psychrometric charts. Also included are tables showing barometric reading corrections, jet velocity from an ideal nozzle for each Btu, squares of numbers and common logarithms.

Typical applications of a new chart, "Low-Quality Steam," for steam and water mixtures having qualities less than 80% are found in problems pertaining to water circulation in boilers, blowoff from boilers, and flow of wet mixtures through orifices, pipes and valves.

Charts for steam and water are based on *Thermodynamic Properties of Steam*, by Keenan & Keyes; those for ammonia on *Circular* 142, *U. S. Bureau of Standards*, and those for Freon-12 on the tables of Buffington and Gilkey. The psychrometric charts are based, in large part, on data given in "A Review of Existing Psychrometric Data in Relation to Practical Engineering Problems," by Carrier & Mackey, *ASME Transactions*, 1937.

ABC of Mathematics

MATHEMATICS *(second edition;* 1944*) By John W Breneman, C E, Associate Professor of Engineering Mechanics, The Pennsylvania State College. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 224 pages, 5½x8½, illustrated, cloth.* $1.75.

This is a book for the man with only a common-school education—nothing highbrow, just ABC mathematics. Subjects covered, with problems showing practical applications in industry, are: simple operations, common fractions, decimal fractions, ratio and proportion, powers and roots, areas and volumes of simple figures; circular speeds, tables, formulas, fundamentals of algebra, equations, simultaneous equations, geometrical constructions, trigonometry, oblique triangles, logarithms, solutions of triangles by logarithms.

Welding

THE OXY-ACETYLENE HANDBOOK (1943) *Published by The Linde Air Products Co, 30 East 42nd St, New York 17, N. Y. 587 pp, 6x9¼, 405 illustrations, cloth.* $1.50 *in U. S.,* $1.80 *elsewhere.*

From cover to cover this book has up-to-the-minute practical information for gas welder, inspector, engineer and instructor. Filling a long-felt need for a comprehensive, authoritative textbook on basic oxyacetylene welding and cutting procedures, it covers the entire range of these processes. It gives clear, easy-to-follow instructions for handling common commercial metals, with simple explanations of the fundamental principles of various methods of depositing and controlling molten metal.

Here is a book that tells how to identify metals; apply hard facing and flame hardening, cut and weld all common metals, develop welding procedure controls, organize and lay out a welding shop, adjust a flame, use and operate it, and care for oxyacetylene equipment. It not only teaches students how to weld and cut, but also shows experienced welders how to improve their technique. Whatever your interest in the uses of the gas torch, this book will be a valuable addition to your library.

Conversion Factors

CONVERSION FACTORS AND TABLES (1944) *By O T Zimmerman, professor of chemical engineering, University of New Hampshire and Irvin Lavine, formerly professor of chemical engineering, University of North Dakota. Published by Industrial Research Service, Dover, N. H. 262 pp, 4½x6, semi-flexible binding.* $2.75.

Scientific and technical workers frequently have to make conversions from one system of measurements to another. These conversions often involve a combination of a number of quantities. This in its simplest form requires considerable time and frequently is a troublesome operation.

Generally memory is not sufficient and reference must be made to some source of constants. This little book, compiled to serve as that source, provides in one volume an accurate source of fundamental physical relationships as well as about seven thousand useful constants for the conversion of units. Practically every system of measurement is included so that the book will be useful to every technical worker.

Electrical History

PRODIGAL GENIUS: *The Life of Nikola Tesla* (1944) *By John J O'Neill, science editor, New York Tribune. 326 pp, 6x8¼, cloth.* $3.75.

Biographers generally underrate or overrate their subjects. Few who are in a position to judge Tesla's work would say, as his biographer does, that "he rated the status of the Olympian gods" and that "he stands as a synthetic genius, a self-made superman, the greatest invention of the greatest inventer of all times." However, aside from

(*Continued on page* 148)

Anaconda Copper Tubes

HELP DRIVE TORPEDOES

FEW WEAPONS demand more attention to detail or higher precision than the naval torpedo. In fact, the task of assembling all of the essential parts into the limited space available requires the utmost skill and ingenuity.

In fabricating the tube illustrated, The G & O Manufacturing Company of New Haven, Conn., selected Anaconda Copper Tubes for uniform softness and strength. These special tubes range in size from ½" to 1" O.D. and in wall thicknesses up to ⅛". They must withstand varying test pressures, which for certain sizes and gages go up to 5,000 lb. per square inch. Bending radii are held to a tolerance of plus and minus 1/32". Copper or brass collars are brazed to the tube ends with naval brass rod and then machine finished.

The American Brass Company has facilities for the production of copper tubes in all standard sizes and wall thicknesses, and is equipped to manufacture special tubing according to specification.

4465

BUY WAR BONDS . . . buy more to shorten the war.

ANACONDA *Anaconda Copper Tubes*

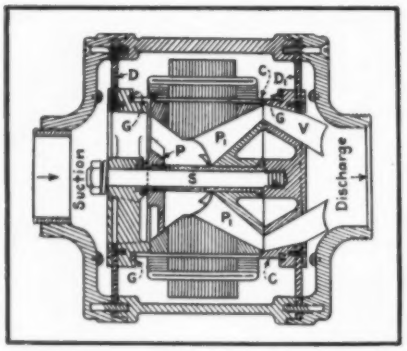
THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

What's New in Plant Equipment

Motor-Pump

PEZZILLO PUMP combines impeller of an axial-flow propeller pump and rotor of an induction motor in a single compact unit of motor dimensions. Pump is built inside



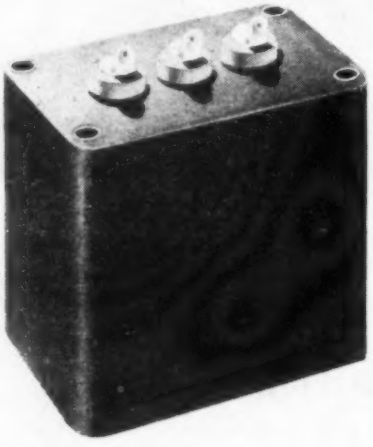
the motor rotor, which serves as its casing. The rotor with its internal pump impeller is suspended from the stator frame on two rubber diaphragms, *D* and D_1. Diaphragm *D* carries the pump's-suction eye and D_1 the diffuser vanes *V* in the pump discharge.

Impeller runs on a shaft *S* fixed on pump's eye and diffuser. There are two impellers *P* and P_1. Impeller *P* gives fluid initial acceleration before it reaches main impeller P_1. Rotating element and pumped liquid are isolated from motor's stator by a thin high-resistance metal cylinder *C* in the air gap between stator and rotor. This cylinder makes a tight fit in the stator bore and is closed at its end by a gasket *G* in suction-eye and diffuser castings.

When fluid does not have lubricating qualities the pump's impeller and motor rotor are supported on a hollow, fixed shaft held in suction-eye and diffuser castings. Oil admitted to shaft's center flows through holes in its shell to lubricate bearing. Advantages are said to be that design is compact and simple, no packing is needed, and unit can be connected directly in straight pipelines. In small sizes, pipeline need be the pump's only support. Present designs are in sizes up to 500 gpm and 50-ft head. *Albert R Pezzillo, 2822 N 26th St, Philadelphia 32, Pa.*

Steam Condenser

DAWES CONDENSER is claimed to offer at least a 100% increase in capacity over conventional condensers having equal tube area based on the internal dimension of tubes. Design enables retubing and cleaning without long shutdowns. Condenser is also said to be one third the over-all size of comparable conventional condensers and is proportionately less heavy. Tubes are of special extruded surface construction. In an installation utilizing a series of Dawes condensers, manifolded, a single unit may be quickly cut in or cut out. By carrying a standby unit on the manifold, there is no loss in power. Present designs call for units up to 10,000 lb steam per hr, at whatever desired vacuum up to 29 in. Hg. These units may be manifolded in series to provide greater capacity as required. *Contract Engineering, San Francisco, Cal.*

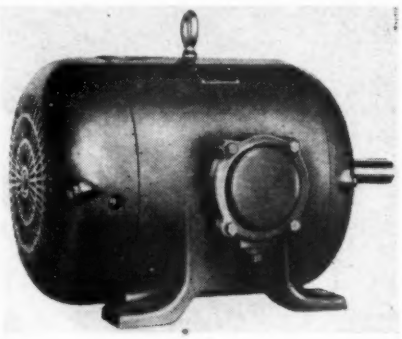


Interstage Filters

BPI INTERSTAGE FILTERS have a primary impedance of 10,000 ohms and operate from the plate of a triode tube to a succeeding grid. The gain is about 2 to 1. BPL filters operate from a line impedance of either 500 or 600 ohms to the tube grid. Gain is about 9 to 1. *United Transformer Co, 150 Varick St, New York 13, N. Y.*

Insulation Gun

GUN SYPHONS DRY THERM-O-FLAKE insulation direct from shipping carton, mixes with water and sprays to refractory wall in one operation. Premixing is eliminated. Application is claimed to be six to eight times faster than by manual methods. *Therm-O-Flake* gun, 4 lb, operates on standard air and water pressures. Units are complete with 15-ft sections of air, water and vacuum hose and all necessary valves and fittings. *Illinois Clay Products Co, 608 S Dearborn St, Chicago 5, Ill.*



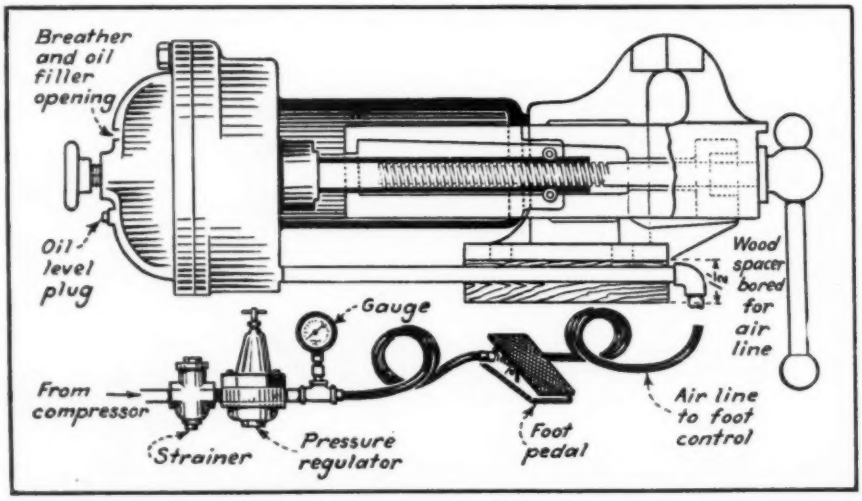
Explosionproof Motor

MOTOR CONSTRUCTION meets the specifications of and carries Underwriters Laboratories label for Class I, Group C installations where surrounding atmosphere is charged with ethyl ether vapor. This is an addition to Century's explosionproof motor line for hazardous locations. *Century Electric Co, 1806 Pine St, St. Louis 3, Mo.*

Vise Attachment

BY A COMPACT ATTACHMENT, known as *Vi-speed*, any standard 4- or 4½-in. vise can, it is claimed, be changed from hand to air operation. New unit (*shown below*) is a pneumatic cylinder that is fastened to the vise body, while the piston rod is connected to the screw. Air up to 100 psi is applied by a foot valve, toe pressure on the pedal closing jaws and heel pressure

(*Continued on page* 168)



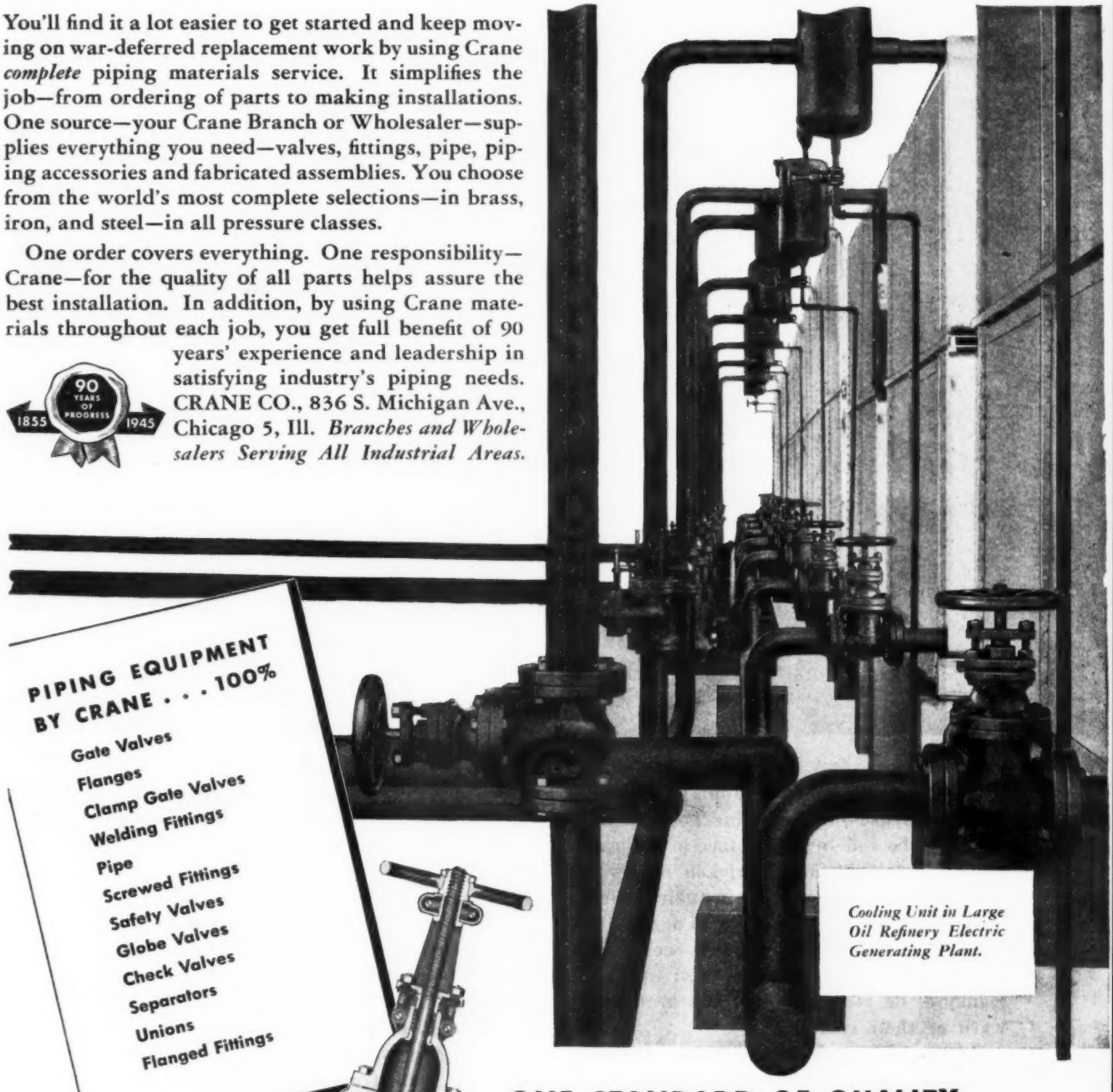
For any Power System . . . Crane supplies all piping parts

ONE SOURCE OF SUPPLY . . . ONE RESPONSIBILITY FOR MATERIALS

You'll find it a lot easier to get started and keep moving on war-deferred replacement work by using Crane *complete* piping materials service. It simplifies the job—from ordering of parts to making installations. One source—your Crane Branch or Wholesaler—supplies everything you need—valves, fittings, pipe, piping accessories and fabricated assemblies. You choose from the world's most complete selections—in brass, iron, and steel—in all pressure classes.

One order covers everything. One responsibility—Crane—for the quality of all parts helps assure the best installation. In addition, by using Crane materials throughout each job, you get full benefit of 90 years' experience and leadership in satisfying industry's piping needs. CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*

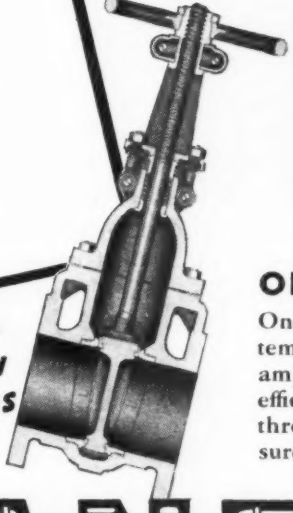
90 YEARS OF PROGRESS 1855 1945



Cooling Unit in Large Oil Refinery Electric Generating Plant.

PIPING EQUIPMENT BY CRANE . . . 100%

- Gate Valves
- Flanges
- Clamp Gate Valves
- Welding Fittings
- Pipe
- Screwed Fittings
- Safety Valves
- Globe Valves
- Check Valves
- Separators
- Unions
- Flanged Fittings



STANDARD IRON BODY WEDGE GATE VALVES

ONE STANDARD OF QUALITY

One highly dependable quality guards every part of piping systems when Crane materials are used from end to end. For example, here's how Crane Iron Body Valves increase pipe line efficiency. Strong body sections resist severest stresses. Straight-through ports permit unrestricted flow. A deep stuffing-box insures tightness and lengthens packing life.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

THE *Fifth Horseman*

The Bible tells us of the Four Horsemen of the Apocalypse—War, Famine, Pestilence and Death—who rode over the face of the earth, leaving smoking ruins, stricken bodies and the foul odor of the grave in their wake.

They ride today, so it is worth our while to remember, too, Philip Wylie's companion story of the Fifth Horseman. Full of pity for mankind, he rode ahead of his brothers to warn of their coming.

He tried in vain. People, busy with their normal and frivolous lives, scarcely looked up as he passed. When his grim brothers arrived, the people were caught unawares.

Sadly, he rode back through the broken and devastated land, sick at heart. Wherever he rode now, people looked up—but only to curse and to revile him. "You knew," they cried, "and you didn't warn us. You should have made us listen!"

Angry and despairing, the Fifth Horseman joined his terrible brothers, burning, killing and destroying even more than the others.

The name of that Fifth Horseman was REALITY.

I remember this legend with the better-known Bible story because war's end in this year of 1945 will bring again the warning of the Fifth Horseman—to each of us, and to all of us. We must work together—as a nation, and as Allies—against a return—ever—of his four grim brothers. If we don't, he too may ride against us, a greater scourge than all of the others together.

George Edwards

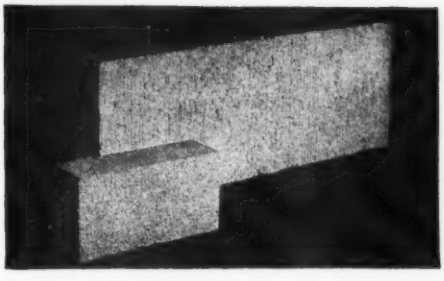
ENGINEER

Solutions

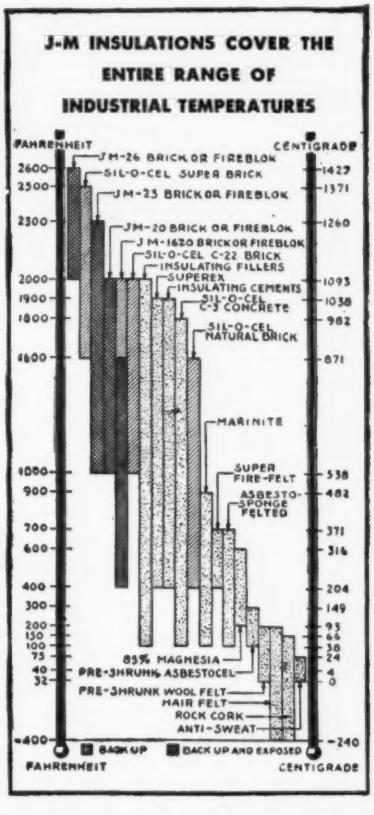
TO YOUR TOUGH INSULATING PROBLEMS!

WHATEVER your insulating problem, there's a Johns-Manville insulation that can solve it efficiently and at minimum cost. For, over the past 86 years, J-M's extensive laboratories have pioneered in the field of industrial insulation. Today J-M offers a wide line of insulating materials, each designed for some specific insulation need, for temperatures up to 2600°. For example:

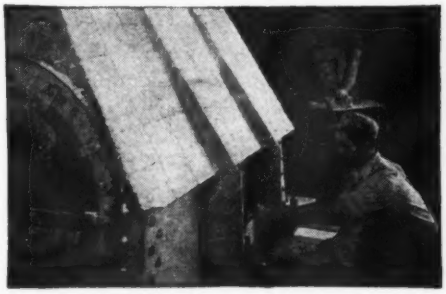
For temperatures to 600° F. J-M 85% Magnesia has been for many years the most widely used block and pipe insulation for temperatures to 600° F. and, in combination with Superex, for higher temperatures. Maintains high insulating efficiency. Standard block sizes 3″ x 18″, 6″ x 36″ and 12″ x 36″; from 1″ to 4″ thick.



Furnace insulation up to 2600° F. J-M Insulating Brick and Insulating Fire Brick are available in 7 types, temperature limits from 1600° F. to 2600° F. All provide light weight, low conductivity. New Insulating Fireblok, now ready in all four Fire Brick types, are 5 times larger for speedier, more economical installation.



For steam lines up to 700° F. Use J-M Asbesto-Sponge Felted Pipe Insulation for efficiency, high salvage and resistance to abuse. For temperatures over 700° F. use with Superex. In 3-ft. lengths 1″ to 3″ thick.



Insulation for temperatures to 1900° F. J-M Superex Blocks have long been standard for this service. High heat resistance, low thermal conductivity. Sizes 3″ x 18″, 6″ x 36″ and 12″ x 36″; from 1″ to 4″ thick.

For more details on these materials, and on the complete J-M Insulation line, write for Catalog GI-6A. Address: Johns-Manville, 22 East 40th Street, New York 16, New York.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville INDUSTRIAL INSULATIONS

FOR EVERY TEMPERATURE . . . FOR EVERY SERVICE

POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

CONVENTIONS • MODERNIZATION POINTERS • FUEL CONSERVATION

NAPE Honors for Joseph F Carney

The Greater New York Association No. 1 of the National Association of Power Engineers, recently honored Joseph F Carney at a dinner celebrating his 50th anniversary as a member of that association. Mr Carney has attended 44 yearly national conventions, served as national president in 1905, and is still active in the national association. In 1940 he was awarded the Robert Grimshaw medal for his outstanding achievements in engineering during the previous year.

Serving his machinist apprenticeship with the Morgan Iron Works, builders of the first White Fleet, he later spent several years as erecting engineer for the Payne Engine Co and Wright Engine Works.

Mr Carney first entered the hotel field as chief engineer at the old Hoffman House. He later went to old Sherry's and in 1912 became building superintendent of the McAlpin Hotel. He now holds the position of building superintendent of the Waldorf-Astoria Hotel and is a member of the board of directors of Louis Sherry, Inc. and The Savarins, Inc. Mr Carney has also been a member of the American Society of Mechanical Engineers for more than 30 years.

Warren D Lewis (*right*) NAPE natl president, presents Joseph F Carney with 50-year anniversary gift pen and pencil from Greater New York Association No. 1

Boiler Drums Floated Up New York's East River

Two monster 90-ton drums for separating water and steam, part of two steam-generating units for the Hell Gate electrical generating station of Consolidated Edison Co of New York, arrived at their destination recently.

The drums measure six feet inside diameter, 57 feet, two inches long, and are made of 70,000 psi ultimate tensile steel plate, 3$\frac{1}{2}$ inches thick. Too large to ship by ordinary methods, they were transported from the maker, Babcock & Wilcox Co, Barberton, Ohio, in two specially built freight cars to allow greater height clearance, and were floated twelve miles by barge from the railroad terminus to their point of erection at Hell Gate. The barge, known as the derrick lighter *Monarch*, is the only one in New York harbor capable of handling single lift weights up to 235 tons. The drums were unloaded onto the dock by a 98-foot boom, or swinging arm, and thence placed on rollers ready to be skidded into position in the boiler room.

The two steam-generating units, of which these drums are a part, are also being built by Babcock & Wilcox Co. Each entire unit is 142 feet in height and the floor space covered by each boiler unit is 3300 square feet. Continuous evaporating capacity of each boiler unit is 900,000 pounds of steam per hour, with a design pressure of 1100 pounds per square inch. Transportation officials estimate that it will require three 100-car train loads to ship the entire two units.

Thirty Power Plants Ordered for Soviet

Devastated power plants, factories and cities of the Soviet Union have ordered 30 turbine-generators from the Joshua Hendy Iron Works of Sunnyvale, Calif. The power plants, it is understood, will be used as package units to supply electricity in ravaged areas recaptured by the Russians from the retreating Germans. Preliminary work is already under way on the sets, of which ten will deliver 2000 kilowatts each and the remainder 500 each. These turbines are of a design for installation as industrial or electric generating plants, and will be marketed as postwar products. Hendy officials revealed at the same time that they are submitting bids to several foreign countries for the manufacture of a variety of industrial power equipment.

Although other orders have been booked, award of the new contract, which calls for early deliveries, is the company's first major venture into the postwar field. It necessitates the employment of more technical and mechanical workers. Currently, the plant is starting on a $30,000,000 naval ordnance contract, with full production promised by the end of the year.

During the past three years, the plant has turned out large quantities of big steam engines, main-propulsion steam turbines, auxiliary turbine-generator sets, diesel-generator units and ordnance material, chiefly for the U. S. Maritime Commission and Navy.

(*Continued on page* 192)

"here is a thought Joe . . . when wrestling with corrosion troubles"*

says *Ed. Fellows*

Nalco Representative, Houston, Texas

WELDING patches over corroded areas in water-jackets is a nasty job any way you look at it. Many plant engineers are ducking this task, Joe, by eliminating excessive corrosion with Nalco water treatment. There is no guess work in connection with the Nalco system . . . we just get down to brass tacks on *your own particular water treating problem* — with scientifically prepared chemicals, scientific research and a competent service staff.

Ask for a Nalco survey today . . . there is no obligation.

Photo in Nalco Laboratories

*Plant Engineer Joe says — "Excessive corrosion in our water jacketed heating tanks is another worry we have to wrestle with. These tanks are 6½ ft. in diam., 15 ft. long, and the heating water through the jacket is around 140° F . . . "

Source: Survey conducted by a well-known power publication.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

Nalco . . . The Complete Water Treating Service

OUT OF THIS *Torture*

IN THIS FURNACE valve bodies were heated, in preparation for shock tests, to temperatures as high as 1500°F., far exceeding any that would be encountered in service.

TESTED BY WATER SHOCK! When thoroughly heated to the desired temperature, the valve bodies were removed from the furnace and immediately drenched with a 2½ inch stream of cold water under 80 lbs. pressure for one half minute. No damage or cracks resulted.

TESTED BY IMPACT SHOCK! After the water test, the flanges were subjected to 8 blows (about 75 foot pounds) with a twelve pound sledge hammer. In spite of this extreme punishment, no cracks developed, a remarkable display of enduring toughness.

Chamber COMES DRAMATIC PROOF!

JENKINS AIR FURNACE MALLEABLE IRON VALVES

survive many times the punishment of the most destructive service conditions

Hundreds of users have learned that they can count on Jenkins Air Furnace Malleable Iron Valves to perform perfectly under the conditions for which they are recommended . . .

But just how much *extra* punishment can they stand? To find out, a "torture chamber" was set up in the Jenkins plant. Here stock malleable iron valve bodies were subjected to extremes of temperature and impact shocks far exceeding any normal service. Yet every valve withstood these tests without the slightest damage. Every single one displayed the kind of stamina you would ordinarily expect only from carbon steel valves!

Such endurance may well be just what you need for the tough valve spots in your plant. And since they are priced considerably lower than steel, Jenkins Air Furnace Malleable Iron Valves may save you money in more ways than one. Use them for *steam pressures up to 150 lbs., and temperatures up to 450°F.*, whenever shocks and vibration are abnormal, or corrosive conditions severe.

A complete 4-page report of the "torture chamber" tests will be sent at your request. Write for Test Report No. A10.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.

MEET U. S. STANDARDS
Jenkins Air Furnace Malleable Iron Valves meet standards of U. S. Maritime Commission, and Bureau of Marine Inspection and Navigation, U. S. Coast Guard.

ONLY AIR FURNACE MALLEABLE MEASURES UP TO THESE SPECIFICATIONS

Don't confuse Air Furnace Malleable with other types of malleable iron. Top-rated grade is Air Furnace Standard Specification ASTM-47-33, Grade No. 35018 . . . used by Jenkins.

COMPARE	TENSILE STRENGTH	SHOCK RESISTANCE		TEMPERATURE LIMIT	CORROSION RESISTANCE (Relative)
		YIELD POINT	ELONGATION IN 2 INCHES		
ASTM 126-30 CAST IRON	34,000 LBS. PER SQ. IN.	0	0	TO 450°F	
ASTM 47-33 AIR FURN. MALL. GRADE 35018	53,000 LBS. PER SQ. IN.	35,000 LBS. PER SQ. IN.	18%	TO 450°F	
ASTM 95-36 CARBON STEEL	70,000 LBS. PER SQ. IN.	36,000 LBS. PER SQ. IN.	22%	TO 750°F	

JENKINS VALVES

SINCE 1864

BRONZE · IRON · STEEL

FOR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING-HEATING SERVICE

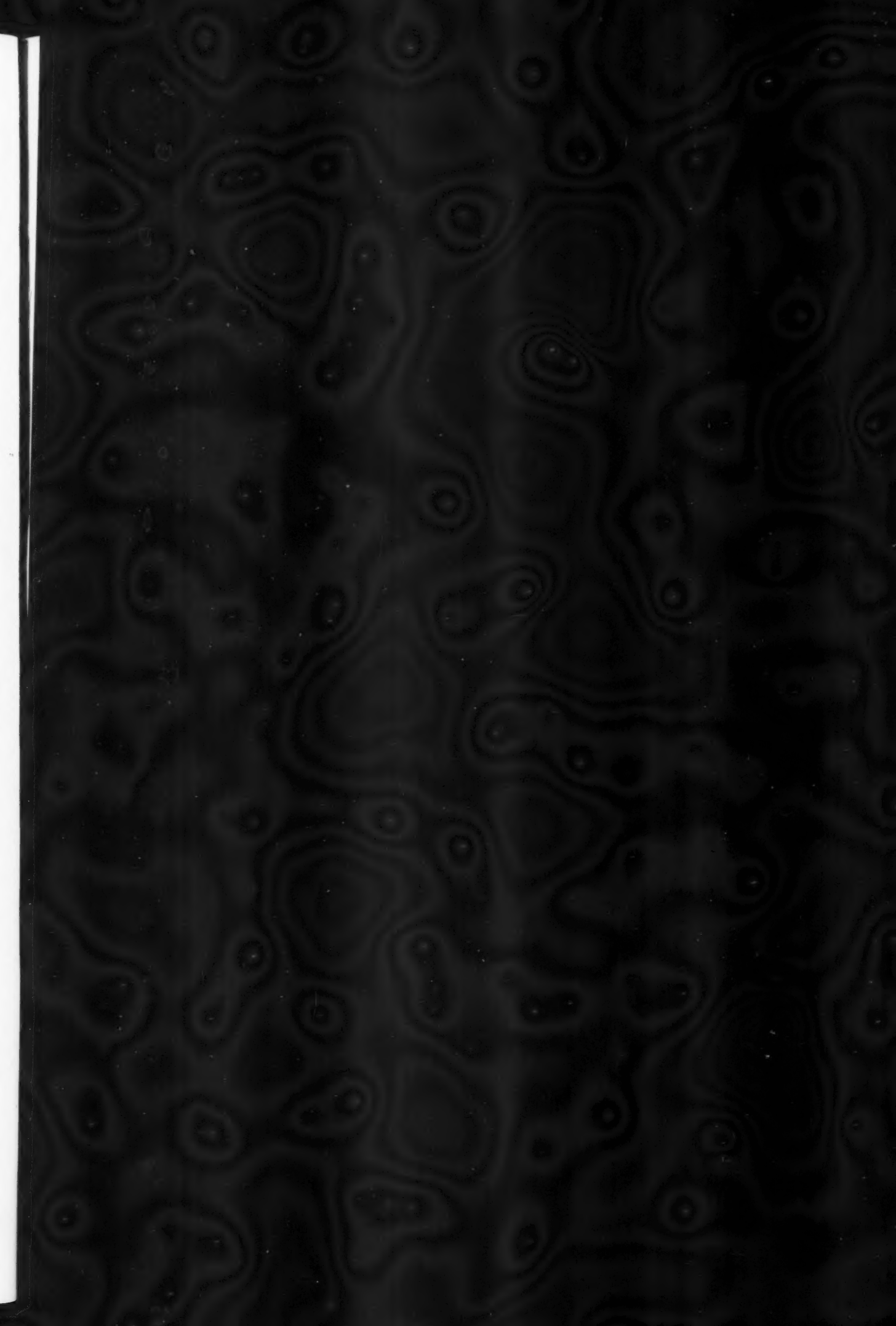
SOLD THROUGH RELIABLE INDUSTRIAL DISTRIBUTORS EVERYWHERE

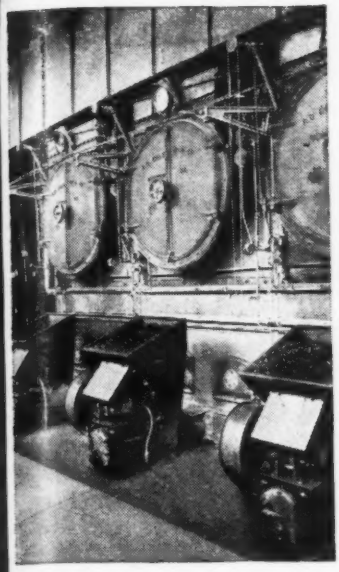
1945 WORK SCHEDULE

Two men per shift. Each man works six 8-hour shifts per week

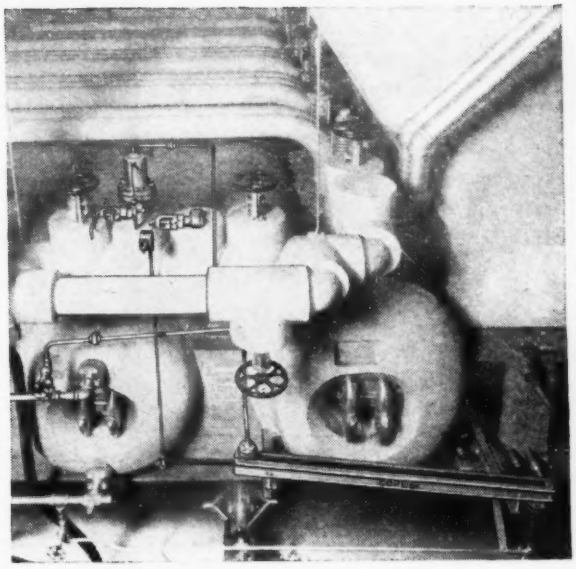
1945 Calendar								Day	A	B	C	D	E	F	G
JAN	19	9	28	16	3	22	10	Mon	Nite	Day	Eve	Nite	Day	Eve	Off
2	20	10	29	17	4	23	11	Tue	Off	Day	Eve	Nite	Day	Eve	Nite
3	21	11	30	18	5	24	12	Wed	Day	Off	Eve	Nite	Day	Eve	Nite
4	22	12	31	19	6	25	13	Thur	Day	Eve	Off	Nite	Day	Eve	Nite
5	23	13	JUN	20	7	26	14	Fri	Day	Eve	Nite	Off	Day	Eve	Nite
6	24	14	2	21	8	27	15	Sat	Day	Eve	Nite	Day	Off	Eve	Nite
7	25	15	3	22	9	28	16	Sun	Day	Eve	Nite	Day	Eve	Off	Nite
8	26	16	4	23	10	29	17	Mon	Day	Eve	Nite	Day	Eve	Off	Nite
9	27	17	5	24	11	30	18	Tue	Day	Eve	Nite	Day	Eve	Nite	Off
10	28	18	6	25	12	31	19	Wed	Off	Eve	Nite	Day	Eve	Nite	Day
11	MAR	19	7	26	13	NOV	20	Thur	Eve	Off	Nite	Day	Eve	Nite	Day
12	2	20	8	27	14	2	21	Fri	Eve	Nite	Off	Day	Eve	Nite	Day
13	3	21	9	28	15	3	22	Sat	Eve	Nite	Day	Off	Eve	Nite	Day
14	4	22	10	29	16	4	23	Sun	Eve	Nite	Day	Eve	Off	Nite	Day
15	5	23	11	30	17	5	24	Mon	Eve	Nite	Day	Eve	Off	Nite	Day
16	6	24	12	31	18	6	25	Tue	Eve	Nite	Day	Eve	Nite	Off	Day
17	7	25	13	AUG	19	7	26	Wed	Eve	Nite	Day	Eve	Nite	Day	Off
18	8	26	14	2	20	8	27	Thur	Off	Nite	Day	Eve	Nite	Day	Eve
19	9	27	15	3	21	9	28	Fri	Nite	Off	Day	Eve	Nite	Day	Eve
20	10	28	16	4	22	10	29	Sat	Nite	Day	Off	Eve	Nite	Day	Eve
21	11	29	17	5	23	11	30	Sun	Nite	Day	Eve	Off	Nite	Day	Eve
22	12	30	18	6	24	12	31	Mon	Nite	Day	Eve	Off	Nite	Day	Eve
23	13	MAY	19	7	25	13		Tue	Nite	Day	Eve	Nite	Off	Day	Eve
24	14	2	20	8	26	14		Wed	Nite	Day	Eve	Nite	Day	Off	Eve
25	15	3	21	9	27	15		Thur	Nite	Day	Eve	Nite	Day	Eve	Off
26	16	4	22	10	28	16		Fri	Off	Day	Eve	Nite	Day	Eve	Nite
27	17	5	23	11	29	17		Sat	Day	Off	Eve	Nite	Day	Eve	Nite
28	18	6	24	12	30	18		Sun	Day	Eve	Off	Nite	Day	Eve	Nite
29	19	7	25	13	OCT	19		Mon	Day	Eve	Off	Nite	Day	Eve	Nite
30	20	8	26	14	2	20		Tue	Day	Eve	Nite	Off	Day	Eve	Nite
31	21	9	27	15	3	21		Wed	Day	Eve	Nite	Day	Off	Eve	Nite
FEB	22	10	28	16	4	22		Thur	Day	Eve	Nite	Day	Eve	Off	Nite
2	23	11	29	17	5	23		Fri	Day	Eve	Nite	Day	Eve	Nite	Off
3	24	12	30	18	6	24		Sat	Off	Eve	Nite	Day	Eve	Nite	Day
4	25	13	JUL	19	7	25		Sun	Eve	Off	Nite	Day	Eve	Nite	Day
5	26	14	2	20	8	26		Mon	Eve	Off	Nite	Day	Eve	Nite	Day
6	27	15	3	21	9	27		Tue	Eve	Nite	Off	Day	Eve	Nite	Day
7	28	16	4	22	10	28		Wed	Eve	Nite	Day	Off	Eve	Nite	Day
8	29	17	5	23	11	29		Thur	Eve	Nite	Day	Eve	Off	Nite	Day
9	30	18	6	24	12	30		Fri	Eve	Nite	Day	Eve	Nite	Off	Day
10	31	19	7	25	13	DEC		Sat	Eve	Nite	Day	Eve	Nite	Day	Off
11	APR	20	8	26	14	2		Sun	Off	Nite	Day	Eve	Nite	Day	Eve
12	2	21	9	27	15	3		Mon	Off	Nite	Day	Eve	Nite	Day	Eve
13	3	22	10	28	16	4		Tue	Nite	Off	Day	Eve	Nite	Day	Eve
14	4	23	11	29	17	5		Wed	Nite	Day	Off	Eve	Nite	Day	Eve
15	5	24	12	30	18	6		Thur	Nite	Day	Eve	Off	Nite	Day	Eve
16	6	25	13	31	19	7		Fri	Nite	Day	Eve	Nite	Off	Day	Eve
17	7	26	14	SEP	20	8		Sat	Nite	Day	Eve	Nite	Day	Off	Eve
18	8	27	15	2	21	9		Sun	Nite	Day	Eve	Nite	Day	Eve	Off

By Charles W Parks, Baltimore, Md.

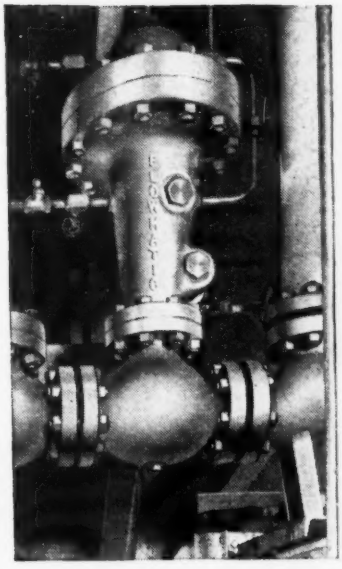




Atlanta Ice & Bottling Co., Atlanta, Georgia. 3 Copes Type OT Regulators installed on HRT Boilers operating at 100 pounds pressure.



Industrial Plant. One of two feed lines to 650-pound pressure C-E Boiler handling a peak of 150,000 pounds per hour, controlled by a Copes Type BI Regulator and Type 3-S-2 Differential Valve.



Eddy Paper Corp., White Pigeon, Mich. Direct-operated Copes Flowmatic Regulator Valve on 550-pound Badenhausen Boiler.

There's a COPES *Feed Water Regulator*
FOR EVERY BOILER REQUIREMENT

SMALL BOILERS?

For HRT, Scotch Marine, and other small boilers, the Copes Type OT Regulator is ideal. Extremely simple, easy to install, compact, direct operated.

Sizes ¾" to 2", 250 and 300 lb. stds.

WATER TUBE BOILERS?

For the conventional water tube boiler subject to ordinary loads, the Copes Type BI Regulator is universally the best known simple level regulator. Fully automatic, thoroughly reliable, smooth acting. Direct or relay operated. Sizes ¾" to 8" all pressure stds.

SENSITIVE BOILERS?

For boilers subject to severe load fluctuations or those sensitive to shrink and swell, the Copes Flowmatic is the correct answer. This steam-flow water-level control is the most rapidly accepted development of recent years. Direct or relay operated.

Sizes 1½" to 8", all pressure stds.

TO be most effective, your feed water regulators must be suited to the particular requirements of the boilers they serve. Boiler design, firing methods, operating procedures, load demands, and space limitations all require consideration.

Whatever your boiler plant characteristics, you will find a Copes Feed Water Regulator that is "made to order." For we manufacture simple level regulators and steam-flow water-level controls in several types, both direct operated and remote relay operated. In addition, every control valve is provided with plunger and ports designed for the existing pressures, temperatures, and rates of flow.

Thus a Copes assures you of individualized feed water control that is in complete agreement with the application. That's one reason why there are over 65,000 Copes Feed Water Regulators in service. For other sound reasons, write for General Catalog No. 12-41.

NORTHERN EQUIPMENT COMPANY

151 Grove Drive, Erie, Pennsylvania

FEED WATER REGULATORS • LIQUID LEVEL CONTROLS • PUMP GOVERNORS
DIFFERENTIAL VALVES • REDUCING VALVES AND DESUPERHEATERS

Branch Plants in Canada, England *Representatives Everywhere*

☆ *For* **SAFETY** *and* **ECONOMY** *Specify*

COPES

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SCHRAMM

AIR COMPRESSORS IN UNIT SYSTEMS

The Unit System of air compressor installations is becoming widely recognized in industry because of the many advantages in taking care of the *variable* compressor loads that exist in so many plants and shops. So often in these shops a lot of air is required at certain periods, a minimum amount at other periods, that Unit installations are desirable.

Another advantage of the unit system is to eliminate unnecessary piping by conveniently installing the compressors in different sections of your plant.

Schramm features: 100% water cooled . . . lightweight and compact . . . is vibrationless, even when providing great amounts of air. These—and many other features—make Schramm the economical air compressor. For full details write today.

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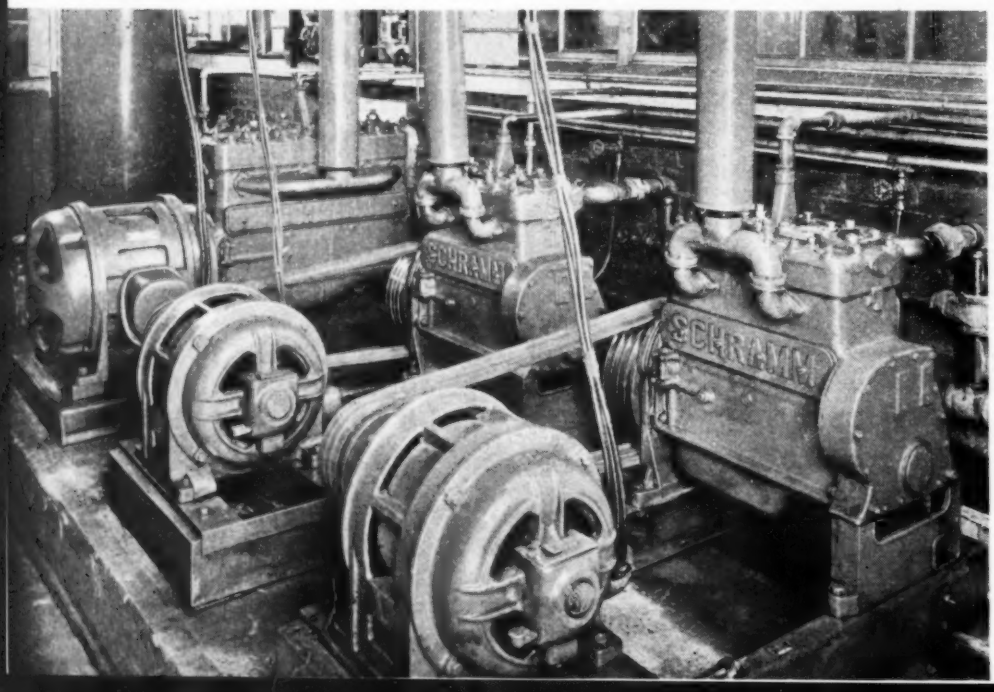


Questions and Answers

(*Continued from page* 124)

Efficiency of boiler =
$$\frac{\text{total heat in steam in Btu}}{\text{heat value of 1 lb fuel in Btu}}$$
= 6390 ÷ 10,200 = 62.6% *Ans.*

Q 25—*If for licensing or other purposes, 10 sq ft of heating surface is taken as equivalent to one boiler horsepower, what would be the rating on this basis of a hrt boiler having the following dimensions: diameter 60 in., length 16 ft, outside tube diameter 3½ in., thickness of tube wall 0.12 in., number of tubes 60? Take lower half of shell, inner surface (gas-contact surface) of tubes and two thirds of area of the tube sheets, less area of tube holes, as heating surface.*

A — Heating surface of shell =

$$\frac{5 \times 3.142 \times 16}{2} = 125.7 \text{ sq ft}$$

Inside dia of tubes =
3.5 − (2 × 0.12) = 3.26 in.
Area of tubes =

$$\frac{3.26 \times 3.142 \times 16 \times 60}{12} = 819.4 \text{ sq ft}$$

Area of tube sheets =

$$2/3\left(5 \times 5 \times 0.785 - \frac{60 \times 3.26 \times 3.26 \times 0.785}{144}\right) \times 2 =$$

2/3 (19.6 − 3.5) × 2 = 21.5 sq ft
Total heating surface =
125.7 + 819.4 + 21.5 = 966.6 sq ft
Nominal boiler hp =
966.6 ÷ 10 = 97 hp. *Ans.*

Q 26—*What is the specific heat of water?*

A—It is the heat in Btu required to raise the temperature of the water one degree. The mean specific heat at atmospheric pressure is 1/180th of the heat required to raise the temperature of 1 lb water through the 180 degrees from 32 to 212 F. It is sufficiently accurate to consider this as 1. Even at higher temperatures this is usually close enough for practical purposes.

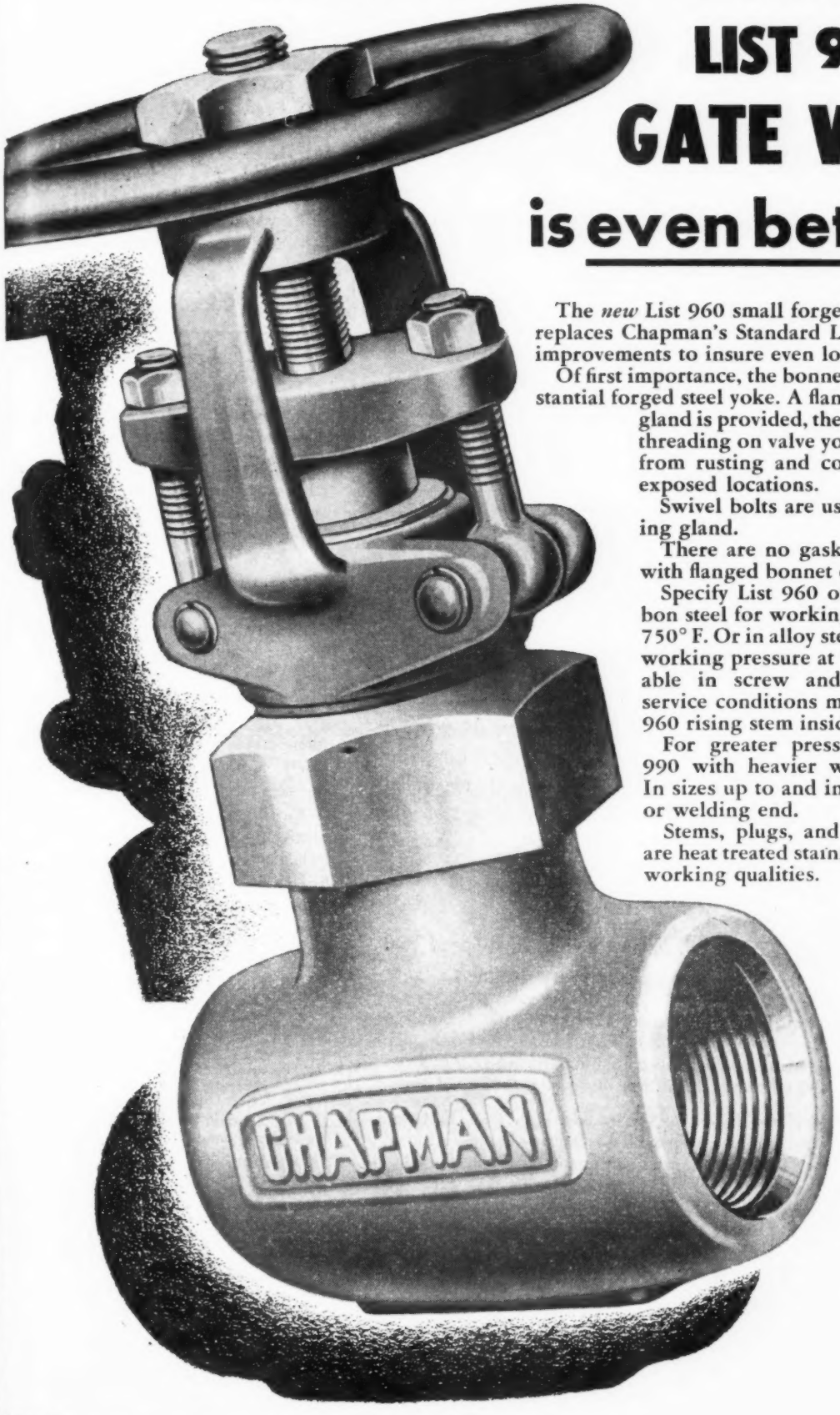
Q 27—*How much heat is required to produce 1 lb of superheated steam at 300 psi abs and 600 F from feedwater at 180 F?*

A—From superheat tables, final heat content (enthalpy) = 1314.7 Btu.
Heat added = 1314.7 − (180-32) =
1314.7 − 148 = 1166.7 Btu per lb.

Q 28—*Sketch and describe a throttling calorimeter.*

A—Fig. 2 shows construction of a common form. It has a cylindrical shell with a thermometer well in the center, an open escape to the atmosphere at the bottom, and two threaded

THE CHAPMAN



LIST 960 GATE VALVE is even better now

The *new* List 960 small forged steel gate valve, which replaces Chapman's Standard List 960, contains several improvements to insure even longer service.

Of first importance, the bonnet is now fitted with a substantial forged steel yoke. A flanged forged steel packing gland is provided, thereby eliminating exposed threading on valve yoke, thus giving immunity from rusting and corrosion when placed in exposed locations.

Swivel bolts are used for holding the packing gland.

There are no gaskets to blow, as in valves with flanged bonnet connections.

Specify List 960 outside screw type in carbon steel for working pressures to 800 lbs. at 750° F. Or in alloy steel for service at 1000 lbs. working pressure at 750° F. Both valves available in screw and welding ends. Where service conditions make it preferable the List 960 rising stem inside screw type is available.

For greater pressures—get Chapman List 990 with heavier walls and extra strength. In sizes up to and including $1\frac{1}{2}$", with screw or welding end.

Stems, plugs, and seat rings on all valves are heat treated stainless steel to insure greater working qualities.

ARMY E NAVY

THE
CHAPMAN
VALVE MFG. CO.
INDIAN ORCHARD, MASS.

Specify Air Express

MILLIONS of dollars are lost annually by the ordinary slow-downs of business and industry due to the constantly recurring need for tools and materials and *waiting for delivery!*

AIR EXPRESS can close many of those gaps between planning and performance, save many of those dollars!

As you put new production plans into operation, you will find AIR EXPRESS at your service with expanded facilities for helping you cut the high cost of idle machines, idle labor, idle goods.

A Money-Saving, High-Speed Tool for Every Business

With additional planes now available for all important types of traffic, 3-mile-a-minute Air Express directly serves hundreds of U.S. cities and scores of foreign countries. Thousands of shippers are saving substantial sums through Air Express, employing its economy and efficiency in an ever-increasing number of ways.

WRITE TODAY for "Quizzical Quiz"—a booklet packed with facts that will help you solve many a shipping problem. Dept. PR-13, Railway Express Agency, 230 Park Avenue, New York 17, N. Y., or ask for it at any local office.

AIR EXPRESS
Gets there FIRST

Phone RAILWAY EXPRESS AGENCY, AIR EXPRESS DIVISION
Representing the AIRLINES of the United States

openings in the sides near the top and on opposite sides. One of these openings connects to the steam line. The other side leads to a *manometer*, a glass U-tube partly filled with mercury and having a scale divided into inches.

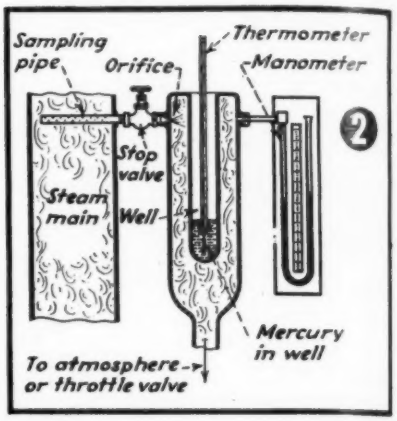


Fig. 2 — Throttling-type calorimeter

Q 29—*Explain the operation of the throttling calorimeter.*

A—Steam from the main steam pipe passes through a nozzle having an opening about 3/100 in. in diameter, which reduces it to approximately atmospheric pressure. Since moderately high-pressure saturated steam contains a greater number of heat units per pound (higher enthalpy) than lower-pressure saturated steam, as can be seen from Table I, this excess heat superheats the steam in the calorimeter, thereby raising its temperature above that of saturated steam at the lower pressure. The thermometer in the central well shows the temperature of the superheated steam. The manometer shows the pressure within the calorimeter.

Using the observed pressure and temperature, quality of the steam can be calculated from the steam tables, using the following formula:

$$q = \frac{H + 0.47\,(t_s - t) - h}{L}$$

where

q = quality of steam
H = total heat in 1 lb steam (enthalpy of saturated vapor) at calorimeter pressure. (To get calorimeter pressure first add the barometer reading to the manometer reading. Multiply this by 0.49 to get calorimeter pressure in psi abs.)
0.47 = specific heat of superheated steam
t_s = temperature of superheated steam in the calorimeter
t = temperature of saturated steam at calorimeter pressure (from steam tables)
L = Latent heat (enthalpy of vaporization) of high-pressure steam in main
h = sensible heat (enthalpy of saturated liquid) of high-pressure steam in steam main

(*Continued on page* 144)

Tonnage that turned the tide

TUBE-TURN welding fittings weigh less—take only a fraction of the space. In the intricate piping systems of Victory ships, these savings increased tonnage capacity that helped turn the tide.

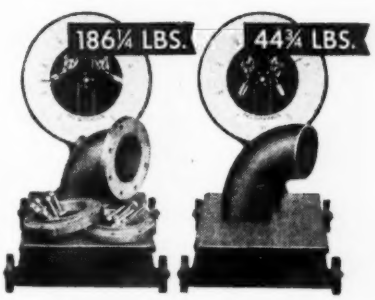
Weight-saving, space-saving, and low maintenance costs are important *in industry, too.* But they are only three of Tube Turns' many advantages over other fitting types. Tube-Turn welding fittings are easy to install. Their vibration-proof strength eliminates shut-downs for piping repairs. Their smooth inner surfaces insure maximum efficiency of flow. They permit greater flexibility of layout. Their greater strength means longer life for the entire system, increased safety at points of highest pressure . . . where direction of flow is changed.

For more information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

• • •

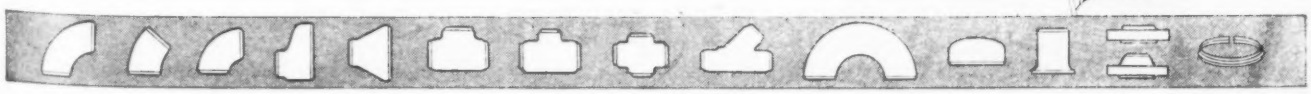
Selected Tube Turns Distributors in every principal city are ready to serve you from complete stocks.

TUBE TURNS (Inc.) Louisville 1, Kentucky. *Branch Offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D.C., Houston, San Francisco, Seattle, Los Angeles.



Less than 1/4 as much weight!
Actual weight of 8-inch cast iron flanged ell with flanges, bolts and nuts, 186¼ lbs. Actual weight of 8-inch Tube-Turn elbow to do the same job, 44¾ lbs.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*



A SMALL SAMPLE
relatively speaking

A 1000 lb. carbon moly header . . . for use on a high pressure line. Small sample, indeed, of the steady stream of industrial piping fabrication that flows through the Associated shops in an endless continuity.

The quantity and the quality of work handled here indicate the exceptional degree of ability available to cope with whatever problem your piping requirements pose . . . Let Associated assume the responsibilities inherent in all fabrication jobs, large or small—for you.

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2332 East 38th Street • Los Angeles 11, California

ASSOCIATED *Progressive* **PIPING**

Q 30—*Sketch and describe a separating calorimeter.*

A—The separating calorimeter separates water from steam, and collects it in a separate chamber where its exact weight may be determined. In Fig. 3 the main body of the calorimeter is a cast-iron double shell. The outer space steam-jackets the inner cylinder to prevent heat loss by radiation. A water glass with a graduated scale is connected to the inner cylinder and a pressure gage to the outer steam space. This gage is graduated to show steam pressure in the outer space, also weight of steam in pounds passing through the calorimeter orifice in a given time.

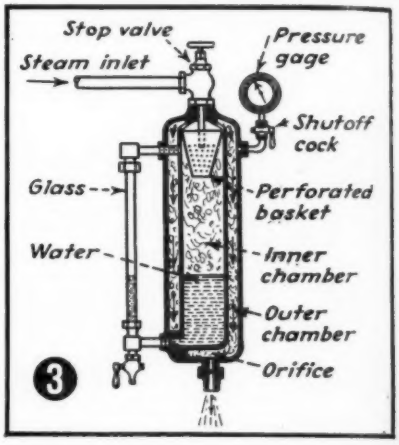


Fig. 3 — Separating-type calorimeter

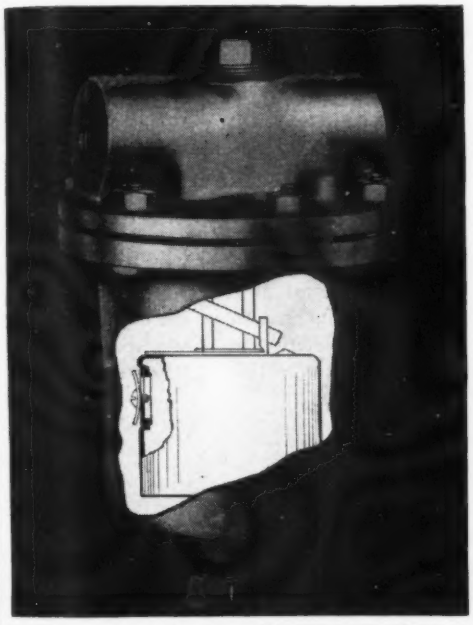
Q 31—*Describe the operation of the separating calorimeter.*

A—When the steam is admitted through the valve at the top of the calorimeter it flows downward into the perforated cup where its direction of flow is reversed. Moisture in the steam, being heavier than the steam itself, is left in the cup and drains down into the bottom of the inner chamber where the amount can be measured on the scale. Dry steam passes upward to top of cup, enters the outer cylinder and finally passes out through the orifice in the bottom. Weight of dry steam flowing can be read on the gage dial, or it can be found by attaching a hose to the outlet at the bottom and leading this hose into a tank of water resting on a scale. By checking the tank's weight and contents before the calorimeter is drained into it and after, difference in weight gives weight of the condensed steam. When weights of the moisture and dry steam are found, then,

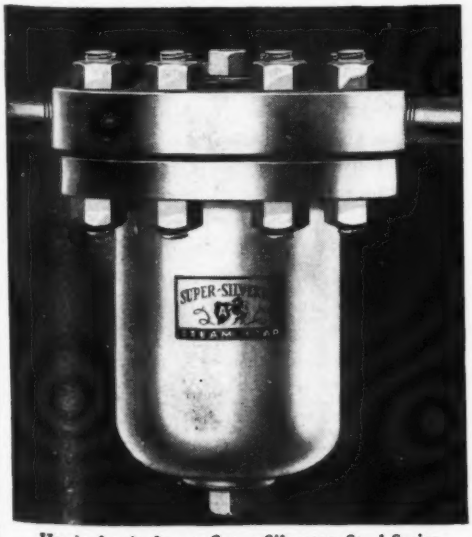
$$\text{Percentage moisture in steam} = \frac{\text{weight of moisture in calorimeter}}{\text{dry-steam weight} + \text{moisture weight}} \times 100$$

Quality of steam =
100 = percent moisture

Super-Silvertop Inverted Bucket Steam Trap can be piped as an elbow or straight-in-line. In either case saving from 6-7 parts and 60 minutes time per trap installation.



Cutaway view of a Super-Silvertop Steam Trap with an Anderson Thermal Air Eliminator installed to assure instant removal of air as well as instant heat to the steam using unit.



Here's the Anderson Super-Silvertop Steel Series trap designed for higher pressures and temperatures . . . Complete in itself and requires no extra fittings nor labor costs.

By the makers of

SUPER-SILVERTOPS

● The makers of Super-Silvertops provide a Steam Trap for every trap purpose . . . More than that, this company makes air release valves and self-cleaning pipe line strainers. Here's the Anderson Steam Specialties lineup:

STANDARD STEAM TRAPS in 8 sizes. All 8 can be equipped with thermal air eliminator.

OPEN FLOAT AND THERMOSTATIC TRAPS in 6 sizes.

FLOAT TRAPS in 7 sizes.

AIR RELEASE VALVES in 10 sizes.

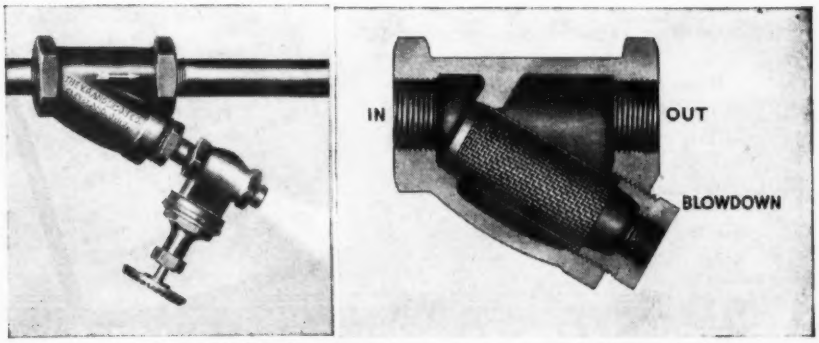
SELF-CLEANING PIPE LINE STRAINERS in 10 sizes.

All of these traps, valves and strainers have been proved best by years of successful use . . . And all are described in detail in the book "How To Choose A Steam Trap."

A free copy is yours for the asking.

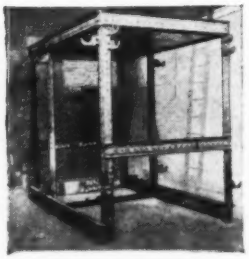
THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland 2, Ohio

Anderson Air Release Valve, sometimes referred to as Air Trap, used to vent air from water or gas from any liquid in a pipeline or closed valve.



Anderson Pipeline Strainers will protect your control equipment from scale, grit or sediment. Self cleaning, easy to install, and inexpensive.

Front and side furnace water-wall sub-assemblies ready to be hung on structural frame work.



Erected boiler frame or structural frame work.

Convectors, rear, roof and side furnace water-walls, with special floor water-wall for oil or pulverized coal firing.

Furnace water-walls and convectors erected with steam drum in place showing insulated steel casing detail.

Boiler enclosed, insulated steel casing showing water-wall and convector discharge piping connected to steam drum.

Boiler completely enclosed with insulated header boxes in place.

A New and Better Way to Erect a Boiler on the Job

THE erection on the job of a Type LFS, International-LaMont Forced Recirculation Boiler is quicker, and easier than any other water tube boiler. Pressure parts of the unit are pre-fabricated, sub-assembled and tested in the shops before shipment. Other parts are sub-assembled and checked for quick erection on the job. In small sizes, the boiler unit can be shipped completely assembled.

Other distinctive features of the Type LFS Boiler are:

The boiler is in complete circulation before the fire is started.

The steam drum is an unfired pressure vessel.

Higher efficiencies due to maximum radiant heat absorbing surface in furnace water-walls and effective arrangement of secondary heating surfaces

Extreme flexibility—follows swinging load from no load to maximum load instantaneously.

Steady water line and dry steam under all load conditions.

Minimum space requirements—low headroom a feature.

International-LaMont Boilers,* Type LFS, are designed for firing with oil, gas, pulverized coal or stokers. They are available in sizes ranging from 4,000 to 30,000 pounds of steam per hour and in all standard working pressures. Larger sizes and special pressures or superheat requirements on request.

Write today for bulletin illustrating and describing special features of this Type LFS Boiler.

*Licensed under LaMont patents.

TYPE FR 20 to 300 h.p. Shipped complete for connection to electric, fuel oil and fresh water supply lines.

TYPE LFR 20 to 100 h.p. Shipped complete for connection to electric, fuel oil and fresh water supply lines.

TYPE CR Firebox Water Tube Boiler 100-125-150 lb. A.S.M.E. Standard 10 to 300 h.p.

Also a complete line of welded firebox water tube heating boilers. 15 lb. A.S.M.E. Standards.

Boiler Builders for 59 Years

THE INTERNATIONAL BOILER WORKS CO.
POWER DIVISION
200 BIRCH STREET · EAST STROUDSBURG, PA.

Reader's Problems

(*Continued from page* 115)

A dependable connection can be made to the 8-in. main by installing a tapped tee in it and making the branch connection of wrought iron or brass, made up with a *swing* joint in the branch, using extra-strong nipples and fittings. Copper connections can also be used although copper usually requires more work space in which to make the bend.

Oak Ridge, Tenn. I A BUTCHER

Calculating Pressure Rise

BEST REPORT on calculating pressure rise from water hammer is the summary by F M Dawson and A A Kalinske published in the American Water Works Association Journal, Vol 31, No. 11, Nov. 1939.

Maximum pressure rise in a closed conduit occurs if the flow is entirely stopped in a period of time equal to that required for the pressure wave to travel from the control valve to the relief point and back. This time depends on length of conduit in feet L and velocity a of pressure wave in ft per sec; thus time $t = \frac{2L}{a}$ and head in ft $h = \frac{a}{g} V$.

$$a = \frac{12}{\sqrt{\frac{W}{g}\left(\frac{1}{k} + \frac{d}{EO}\right)}}$$

Where:

V = Velocity reduction, fps
g = Acceleration of gravity
d = Pipe dia in.
O = Pipe-wall thickness, in.
K = Vol modulus of elasticity of water (294,000)
E = Pipe wall material modulus of elasticity 29,400,000 for steel
W = Weight of water per cu ft, in lb.

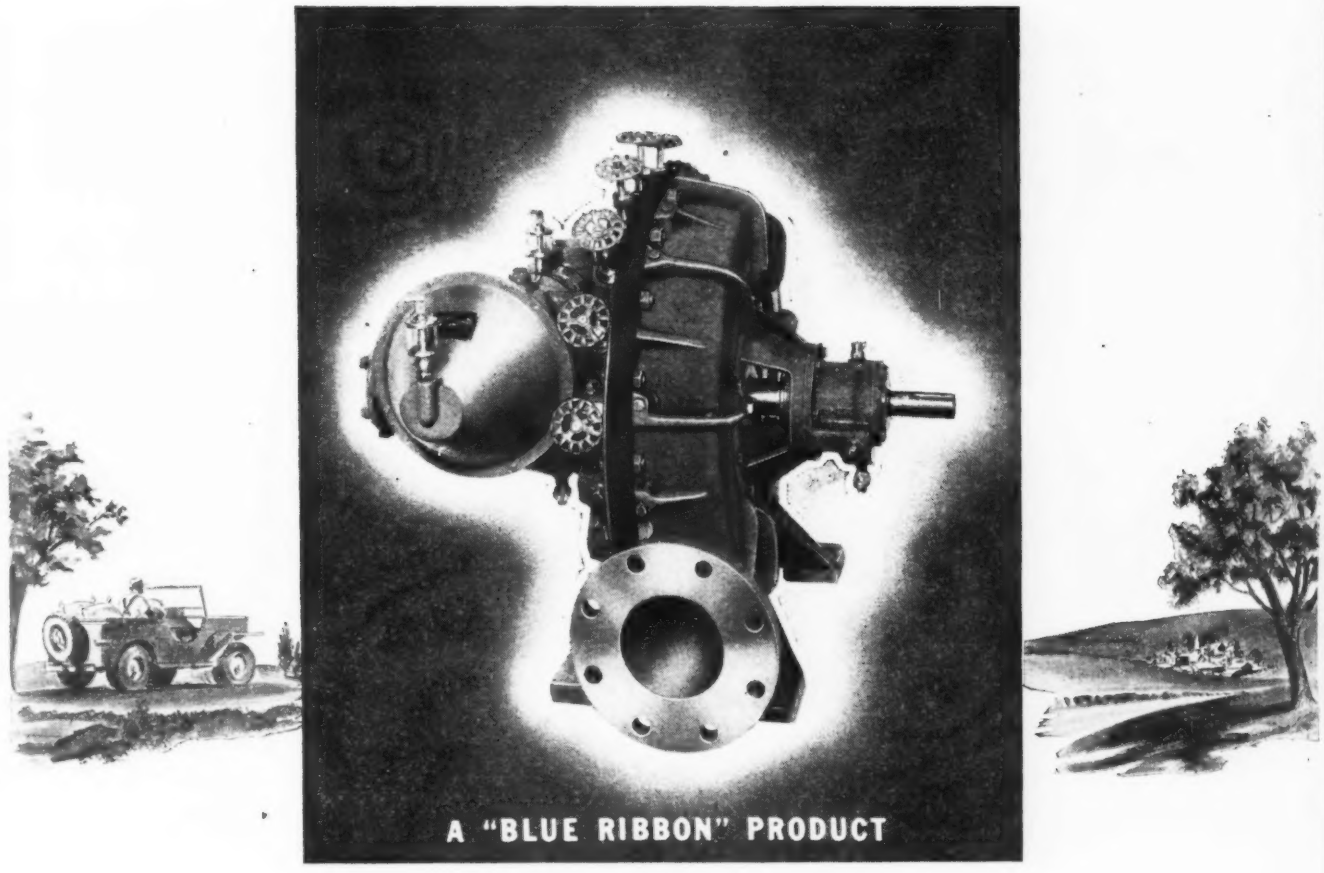
Velocity a of the pressure wave depends on size and material of the pipe and is easily and accurately calculated from the foregoing equations.

Water hammer is caused by the sudden destruction of velocity and its intensity is controlled by the liquid velocity and abruptness of stoppage. Energy is merely transmitted by the flow restriction and is not destroyed.

Tests prove that dashpots, bypasses, counter weights or air chambers, are of little value. In this problem, the air chamber performs little service and probably intensifies the pressure because it is water logged.

West Orange, N.J. R C MCDONALD

(*Continued on page* 148)



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BECAUSE THEY'RE SMALL, BUT POWERFUL, AND GO ANYWHERE

For a small, tough, hard-working turbine that will go anywhere and do all you expect of it . . . get a Coppus "Blue Ribbon" Steam Turbine.

Coppus Steam Turbines come in six frame sizes from 150 HP down to fractional—so you can match more closely your job requirements. Each smaller size is priced correspondingly less, so by selecting "horsepower" instead of "elephant power" you save on investment and installation cost.

Many well-known manufacturers install Coppus "Blue Ribbon" Steam Turbines on original equipment. They know Coppus quality will protect the reputation of their own products. The Coppus Turbine is also being used on many U. S. Destroyer Escorts, all Casablanca class aircraft carriers and 90% of all Landing Ship Docks.

Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), the Coppus Steam Turbine is a precision-made product, with accuracy controlled by Johansson size blocks. Every turbine is dynamometer-tested before shipment.

More than 85% of all orders since 1937 have been repeat orders.

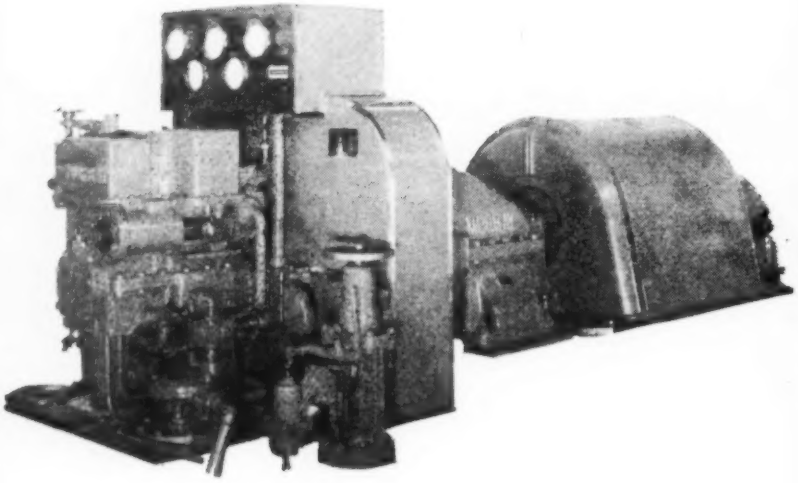
Write for Bulletin 135-9. Coppus Engineering Corporation, 161, Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ANOTHER

COPPUS

"BLUE RIBBON" PRODUCT

FOR POWER
MURRAY
TURBINE GENERATORS



Do you need additional POWER? Are you losing POWER by allowing steam to go through reducing valves to process? Have your plant changes thrown your plant heat balance off from the way it should operate?

Correct the situation with a MURRAY STEAM TURBINE GENERATOR SET, properly designed for your present operating conditions. Whether your plant needs a straight non-condensing unit, or one designed for bleeder or mixed pressure operation, MURRAY has already built a similar machine, now in satisfactory operation for a number of years, among the numerous machines furnished industrial and municipal plants.

There is a MURRAY sales representative near you, ready to serve you, with information or guidance in planning.

MURRAY also produces:

Multistage and single stage Mechanical Drive Turbines
Vertical single stage turbines
High Speed Reduction Gears
Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

Weld Air-Chamber Joints

To PROVIDE against further damage to the lead bends on 8-in. line, move the 4x48-in. air chamber to a point ahead of the reducing valve. If air chamber is made from pipe fittings weld or braze all joints because plain threaded joints are not usually satisfactory for this service.

Fitting the washing machines with valves that close gradually and smoothly as the machines fill will reduce the pressure waves considerably.

Jersey City, N.J. I S CHAMBERLAIN

Use High-Pressure Hose

I SUGGEST that CFJ replace the lead bends with high-pressure flexible-hose and install a relief valve on the system. Air chambers are usually ineffective because they usually contain no air; the slightest leak around gaskets or through a thread joint destroys the cushion. A float-controlled or spring-cushioned valve that closes more slowly reduces the shock.

Kearny, N. J. GEORGE MCNALLY

Engineer's Bookshelf

(*Continued from page* 128)

a few pages of superlatives in the opening chapter, the book is a fairly rational story of a spectacular personality who contributed much to our present electrical age.

Born in an Austro-Hungarian village in 1856, he came to America in 1884 to work for Thomas A Edison. By 1887 he had established his own laboratory in New York City and the next year George Westinghouse paid him a million dollars cash, plus a contract for royalties of one dollar for every motor and dynamo built, for his polyphase alternating-current-system and induction-motor patents. In subsequent years his inventions and discoveries were covered by more than one hundred patents, but he died at 87 almost in obscure poverty.

Those interested in electrical-industry history will enjoy the chapter on the controversy in 1891 over who was the inventor of the rotating magnetic field, the principle on which the induction motor operates. Two other names were put forward for the honor but it has been established that this is Tesla's invention. Those who thirst for the dramatic and spectacular will find it in Tesla's life. He never worked with the commonplace. His interests were always world shaking, millions of volts and cycles, manmade lightning bolts, wireless transmission of power around the world and death-dealing rays. These and many other sensational projects add color and zest to a most dramatic and interesting story.

THE CANADA YEAR BOOK (1943-1944) *By Dominion Bureau of Statistics. Published by the King's Printer, Ottawa. Ont.,*

Leadership Throughout Industry

In every branch of Industry, executives see that machinery they use or make is Timken Bearing Equipped.

This practice has become so standard that in numerous cases it is just a routine matter. When bearings are needed, Timken Tapered Roller Bearings are specified.

Management knows the matchless record of this product—accepted everywhere as the bearing that delivers sustained, dependable performance. Timken Bearings are used in countless types of war material, automobiles, trucks, tractors, locomotives, streamlined trains and industrial machinery generally.

TIMKEN
TAPERED ROLLER BEARINGS

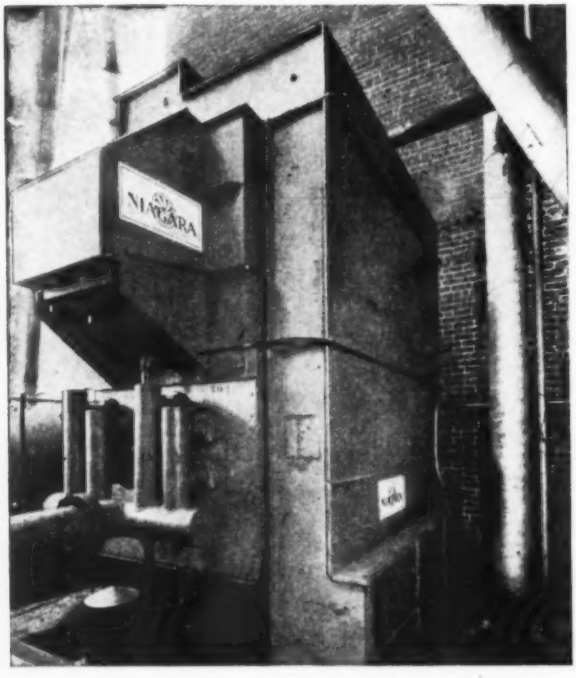
Design, research and experience are the reasons you can trust Timken Roller Bearings no matter how rough and rugged the going.

Your choice of bearings must be selective because the life and operating efficiency of any machine are vitally influenced by the quality of its bearing equipment. The Timken Roller Bearing Company, Canton 6, Ohio.

Improved AFTER COOLING METHOD

DRIES COMPRESSED AIR MORE THOROUGHLY

and Saves Cooling Water Costs



U. S. Patent Re-issue No. 22,533

"BALANCED WET BULB" TEMPERATURE CONTROL

EXTRA DRYNESS is vital to industrial users of compressed air, as in spraying protective coatings or in using air to clean fine instrument parts. And you protect all air tools, grinders, hammers, riveters—from water damage, from freezing and from loss of lubrication when the air is thoroughly dried in the NIAGARA Aero AFTER-COOLER.

Obtaining lower temperatures than with ordinary after-cooling, the NIAGARA Aero AFTER-COOLER produces air that is far drier. An *evaporative* cooler, it does not consume water, but repays its cost by eliminating water bills. It also provides controlled temperature for jacket and intercooler water with the Niagara "Balanced Wet Bulb" control which automatically assures the correct admixture of fresh outdoor air with recirculated air.

Write for Bulletin 96 and 98

NIAGARA BLOWER COMPANY

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INDUSTRIAL COOLING HEATING • DRYING

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HUMIDIFYING • AIR ENGINEERING EQUIPMENT

Canada. 1150 *pp,* 6x9 *in. Illustrated with many maps, charts and tables, cloth.* $2.00.

From the earliest years of the Dominion's history, the Canada Year Book has been the official statistical record of the country's development—its resources and institutions, its social and economic conditions. Conceived from the broadest viewpoint, it presents a co-ordinated picture of progress against a background of interpretative matter designed to give proper perspective.

This book contains statistical information on practically every phase of Canada's development, such as population, power generation and utilization, mines and minerals, manufactures, construction, transportation and communication, labor and 30 other subjects. Those interested in Canadian statistics will find this a most valuable source of information.

Booklet Reviews

THE FLOW OF COAL-ASH SLAG ON FURNACE WALLS *By P Cohen and W T Reid, fuel engineers at the Bureau of Mines Central Experiment Station, Pittsburgh, Pa.* 10c. *a copy from Supt of Documents, Government Printing Office, Washington, D. C.* This technical paper, No. 663, is published to promote more efficient operation of slag-tap pulverized-coal furnaces and to aid in improving design of these large steam-generating units by industry.

BUREAU OF MINES RESEARCH ON THE HYDROGENATION AND LIQUEFACTION OF COAL AND LIGNITE (*Technical Paper* 666) By *Dr Arno C Fieldner, chief, Bureau's fuels and explosives branch, Dr. Henry H Storch, supervising chemist, and Dr Lester L Hirst, physical chemist.* 15¢ *a copy from Supt of Documents, Government Printing Office, Washington,* 25, *D. C.* Review of 8-year research in making gasoline and oil from coal and lignite—potential sources of motor fuels and lubricants when natural petroleum reserves no longer can fill growing demand. It explains hydrogenation and liquefaction experiments at the Bureau's Pittsburgh laboratory-scale plant, a continuous unit capable of hydrogenating 100 lb coal in 24 hr. It also presents chemical-process information in a large number of batch hydrogenation tests in small steel autoclaves or bombs. Experiments show that major part of America's immense coal reserves—estimated at 3 trillion tons—will yield liquid fuels, but some are more easily liquefied than others. Experimental plant tested 15 coals from eleven states and Alaska, from lignite to high volatile bituminous.

Following two booklets are mailed without charge upon individual request for single copies to Bureau of Mines, Dept of Interior, Washington, D. C.

SALVAGE OF COAL FROM MINE REFUSE IN THE PITTSBURGH DISTRICT *By Jos A. Kelly and H G Graham, mining engineers, and Thos Fraser, coal-preparation engineer.* Investigation No. 3768 shows that large quantities of valuable bituminous coal now being dumped into waste piles can be salvaged without drawing upon skilled underground miners, in the Pittsburgh district. About 1,000,000 tons of usable coal can be recov-

CARBONITE PACKING

Carbonite Packing in coil form! It's easy to use... rings are easily cut... and it's unique in that it contains no oil, grease, wax or tar.

Ingredients used—asbestos and graphite—will withstand the highest temperatures of any organic or mineral substances... can be used in temperatures as high as 750° F. Each fiber is treated with a dry binder, making the packing soft, fluffy and perfectly dry.

Carbonite Packing is recommended for use on centrifuga pump shafts, high or low speed; rotary rods or shafts reciprocating rods and plungers; expansion joints; valve stems; and numerous other uses against air, oil or water

There are many advantages in using Carbonite Packing Write today for these details.

THE ANCHOR PACKING COMPANY

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ALLPAX

THE PACKING THAT "PACKS ALL"

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Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

PYREX High Pressure Gauge Glasses are specially designed, manufactured and tested to stand up under the severe punishment of high pressure service.

PYREX High Pressure Gauge Glasses resist pitting and clouding, and retain their crystal clearness throughout their entire life. Their resistance to thermal shock minimizes breakage due to sudden temperature changes. Because of machine drawn accuracy, they are easy to install, and danger of installation strain is reduced to a minimum.

For high pressure duty, in locations where specially high visibility is needed, or for moderate pressure conditions, there is a specific PYREX or CORNING Gauge Glass that has exactly the characteristics to give you long lasting, trouble free, economical service. They are stocked by all leading mill supply houses.

Industrial Sales Department, PO1, Corning Glass Works, Corning, New York.

A complete line to solve your particular gauge glass needs.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

ered yearly in that area, and proportionate tonnages can be reclaimed in other large coal-producing centers.

Picking by hand and using commercial coal-washing equipment are the two methods suggested. Handpicking is done by unskilled workers, and the majority of men in a coal-washing plant are unskilled or unable to stand underground work.

At least one ton of mine refuse is produced for each ten tons of marketed coal in the Pittsburgh area, Bureau engineers found after careful tests for coal content at some mines and general observations at others. Ratio at mechanized mines ran as high as one ton of refuse for every three tons of coal, while at hand-loading operations it was about 1 to 20.

OBSERVATIONS ON THE USE OF CYCLOHEXYLAMINE IN STEAM-HEATING SYSTEMS *By A A Berk. Bureau of Mines Report of Investigation* 3754. First findings of an investigation of the use of cyclohexylamine to prevent or reduce corrosion from carbon-dioxide dissolved in the condensate.

REDUCING HOSPITAL FUEL COSTS *Pub by Hospital Bureau of Standards and Supplies, 247 Park Ave, New York 17, N. Y. 47 pp, illustrated,* $1. Three factors control fuel bills: (1) proper fuel at minimum price (2) efficient equipment for burning fuel and generating steam, and for thrifty and modern use of that steam (3) economical methods for operating equipment that generates, distributes and makes use of the steam. Numerous case histories are reported in operation of heating and power-plant equipment and boilers fired by oil burners and stokers. Hand-fired methods are discussed and references made to boiler efficiencies through different firing methods. Recommendations are given for cutting fuel consumption.

GLOSSARY OF FOREIGN WELDING TERMS *Compiled by M A Cordovi, research assistant, Welding Research Council of The Engineering Foundation. Pub by American Welding Society, 33 W 39th St, New York 18, N. Y. 16 pp,* 50¢. Contractors, students and others who consult welding drawings or specifications using German, French Russian or Spanish terms will find this a valuable supplement to standard or engineering dictionaries.

EXPERIMENTAL STUDIES OF BOILER SCALE AT 800 PSI *By J A Holmes and C Jacklin. 12 pp, available on request from National Aluminate Corp, 6216 W 66th Place, Chicago, Ill.* Reprinted from Proceedings of Fourth Annual Water Conference, Wm Penn Hotel, Pittsburgh, Nov 1 to 2, 1943.

TRANSITION OPPORTUNITIES *Pub by N. Y. Journal of Commerce, 63 Park Row, New York 15, N. Y.,* 25¢. 200 new reports of peacetime trade potentialities and product innovations, secured through key industrialists, government and trade assn officials.

PREPARATION AND PURIFICATION OF HYDROUS OXIDE SOLS BY ION EXCHANGERS *By John W Ryznar,* 3 pp. On request from National Aluminate Corp, 6216 W 66th Place, Chicago 38, Ill.

VALVE troubles result in excessive consumption of lubricating oil, rough running and stalling engines, hard starting. As a rule, most of these valve troubles are caused by mechanical difficulties, although some result from slow speed operation, permitting excessive deposits.

CHIEF CAUSES OF VALVE FAILURE

1. *Insufficient Tappet Clearance* . . . Correction lies in more frequent tappet inspection and accurate clearance adjustment.

2. *Valve Face or Seat off Center* . . . This trouble may result in heavy gum and coke deposits piling up on under side of valve head and forcing it off seat. Here correction lies in proper valve grinding, or replacement.

3. *Warped Valves* . . . Valves that are warped will apparently hang open at high speeds while clearing at idle. Reseating or replacement is only correction. Reducing abnormal temperatures will likely prevent repetition.

4. *Weak Springs* . . . Replace with springs meeting manufacturer's specifications for spring tension.

5. *Worn Valve Guides* . . . Guides become worn from dirt in air intake or oil resulting in coke or gum deposits that build up on valve stems because of excessive oil. This may be corrected by more frequent service of air cleaner or installing more efficient air cleaner; and replacement of worn guides.

6. *Deposits on Valve Seat* . . . This is the most frequent cause of leaky valves with consequent loss in power and fuel efficiency. Source of this trouble is usually heavy carbon or lead deposits in combustion chamber, very rarely from foreign matter within combustion chamber. Narrower valve seats and strong springs with more accurate grinding technique are remedies.

7. *High Temperature Exhaust* . . . Caused either by back pressure due to restricted exhaust system or poor carburetion or late timing. This condition results in warped valves and assists in building up varnish, lacquer, gum or deposits on valve stems, resulting in sticky and/or leaky valves. Cure is to clean out or replace muffler and tail pipe and improve combustion.

8. *Insufficient Cooling* . . . Caused by scale, rust or muddy deposits in water jackets; failure of water pump to deliver enough water; bad vanes in pump; slipping pump belt. In all cases cleansing or repairing of cooling system is called for.

MAIN CAUSES OF STICKY INTAKE VALVES

Intake valves rarely fail or burn because they are constantly cooled by incoming charge of air-fuel mixture. However, they do frequently stick, due to:

1. *Gum Content of Fuel too High* . . . Gum in fuel forms deposits around valve stem above guide and under valve head. To correct, change to fuel of proper specification.

2. *Worn Guides and Stems* . . . Since most of stem and guide wear is due to dirt and dust in air, remedy is more frequent service of air cleaner, or installation of larger capacity oil bath cleaner and, of course, replacement of worn guides and valves.

RING-FREE MOTOR OIL HELPS REDUCE VALVE TROUBLE

Correction of valve trouble is obviously a mechanic's problem. However, motor oil that penetrates fast—gets down around valve stems, and guides—reduces friction, and thereby prolongs life of valve. Macmillan Ring-Free Motor Oil has this quality of fast penetration. Furthermore, it is refined to withstand high engine temperatures. Ring-Free acts as a preventive for valve sticking, saving fuel consumption and costly repair bills.

FREE BOOKLET

Write today for copy of free pamphlet on "Sticky and Burned Valves—Causes and Preventions." Address—Macmillan Petroleum Corporation, Room 1013, 530 W. 6th Street, Los Angeles 14, Calif.

MACMILLAN RING-FREE MOTOR OIL

MACMILLAN RING-FREE MOTOR OIL

MACMILLAN PETROLEUM CORPORATION—50 WEST 50TH STREET, NEW YORK 20 • 624 SOUTH MICHIGAN AVENUE, CHICAGO 5 • 530 WEST SIXTH STREET, LOS ANGELES 14 • COPYRIGHT 1944, MACMILLAN PETROLEUM CORPORATION

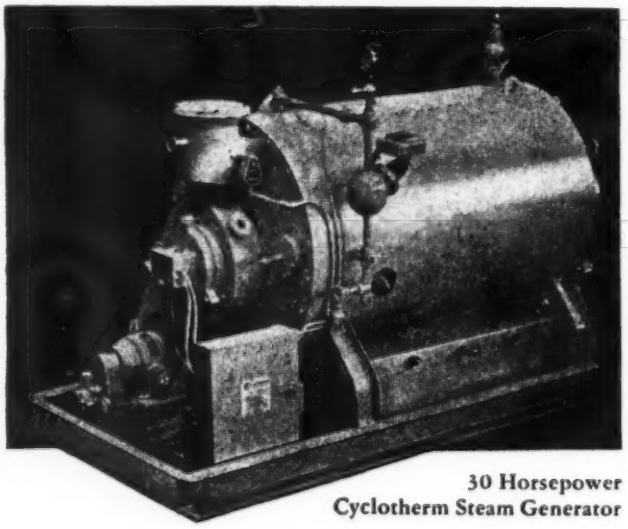
DOLLAR EFFICIENCY—work done per dollar spent—measures the value of steam generation

If you are planning immediate boiler installation or replacement, the efficiency and economy of a Cyclotherm Steam Generator will interest you. While the range of available units obviously cannot be on a peace time basis, Cyclotherm engineers will gladly cooperate in meeting your needs in power, processing or heating with available units.

Cyclotherm meets the dollar efficiency test through a wide power range (10 to 300 horsepower) with both oil and gas fired units. Its exclusive principles of combustion and design have proved Cyclotherm's dollar saving and dollar making capacity under most rigorous operating conditions.

Cyclotherms are fully automatic, sturdily built and completely self contained. They give years of trouble free service with a minimum of attention.

Detailed additional information will be supplied promptly upon request. Our engineers are available for consultation.



30 Horsepower
Cyclotherm Steam Generator

CYCLOTHERM
STEAM GENERATOR

AMES IRON WORKS
OSWEGO . . NEW YORK . . BOX 702

Brush Performance

(*Continued from page* 109)

creases total pressure against the brush holder's side. If top angle is too great it retards brush radial movement. Best operating conditions in trailing position are obtained when brush holder is set at a minimum safe clearance from the commutator, clearance between brush and its holder box kept as small as free movement of the brush permits, and the spring tension finger does not cause a thrust away from the holder's trailing side.

When operated in the leading position, brush angle on the commutator will not change as long as force H is positive. However, in determining the angle at which to set brush holders, allow a safety factor for possible poor commutator surface, abnormally low-temperature operation, continued light-load operation, or use of high-friction brushes. Experience indicates that brushes are liable to chatter at a 20-deg leading angle or less, except on the best commutator surface and with brushes of low frictional coefficient. Probably 25 deg is the smallest safe leading angle, while 30 to 37.5 deg, more often encountered in practice, is preferred. Since pressure against brush holder's side is lower in leading operation than in trailing, a bevel may be used at brush top without seriously reducing radial-movement freedom; this is customary on brushes operated in the leading position.

Curves, Fig. 5, show factor $\frac{P}{T}$, by which spring pressure, T, is multiplied to determine pressure normal to commutator at brush face. These curves show the variation of $\frac{P}{T}$ with brush angles for coefficients of friction ranging from 0.0 to 0.60. They indicate how pressure at brush contact face is modified by changes in brush angle or coefficient of friction. Curves also show that an increase in coefficient of friction decreases pressure on the commutator with brushes in the leading position and increases pressure on the commutator in the trailing position.

With trailing angles, brush-face pressure is always greater than spring pressure parallel to brush length. With leading angles, brush-face pressure is greater than spring pressure at low coefficients of friction and customary brush angles but less than spring pressure at the higher coefficients. For example, in Fig. 5 at a brush angle of 35

(*Continued on page* 158)

What do you want to know about Turbine Oil?

Recently a number of utility plant men were asked, "What do you want to know about turbine oil?" Several of them had very specific questions. They are answered here because they may help you in selecting a turbine oil that solves, once and for all, the ever present problem of turbine oil maintenance. One question is taken up each month, but you can get the answers to all of them now—see the booklet offer.

5. Does the inhibitor in Nonpareil Turbine Oil wear out?

Inhibitors are used in many oils for various purposes, often without users being aware of it. But in Nonpareil the addition of an inhibitor is an important step in its manufacture—it's the key to the oil's long life.

Few, if any, oils are expected to last indefinitely; therefore, the life of inhibitors used in them is not of paramount importance. Since Nonpareil is guaranteed "for the life of the turbine," the lasting quality of the inhibitor *is* important.

It is true that the oxidation inhibitor in Nonpareil is slowly consumed in service. But the user has no cause for concern about it. There are many reasons why. The principal reason is the fact that the inhibitor is used up so slowly—and such a small amount is needed to prevent acidity development—that it is usually amply replenished by the make-up oil. Almost every turbine requires some oil to replace that lost through evaporation and leakage. Normal make-up oil will keep Nonpareil well within the guaranteed limit of acidity formation.

Another reassuring fact is that the oxidation inhibitor has one primary function—to prevent acidity development. The oil itself is free from asphaltene-forming hydrocarbons. Even in the extremely rare case where make-up oil is not sufficient to replenish the inhibitor, there is no formation of asphaltene deposits. However, the possibility of *any* oil trouble because of a deficiency of inhibitor is reduced to practically zero due to the periodic laboratory check that is made of every fill of Nonpareil. Records of thousands of these tests bear out this fact.

What causes corrosion in turbines will be the question discussed in this space next month.

Gasoline Powers the Attack...
Don't Waste a Drop!

For all the answers send for this booklet...it contains answers to questions such as these:

1. What causes turbine oil deposits or sludge?
2. What causes acidity increase in turbine oil?
3. What is an oxidation inhibitor—how does it prevent acidity?
4. How does a guaranteed turbine oil protect the user?
5. Does the inhibitor in Nonpareil Turbine Oil wear out?
6. What causes corrosion in turbines?

Send for a copy of this booklet, or better still, ask for a Standard Lubrication Engineer. He can answer your specific questions about Nonpareil Turbine Oil. Write Standard Oil Company (Indiana), Room 1223, 910 S. Michigan Ave., Chicago 80, Ill., for a copy of the booklet, or the Engineer nearest you.

NONPAREIL TURBINE OIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

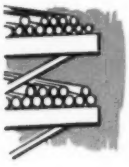
LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Rust prevention made easier and surer with . . .

STANORUST

MOST OILS or greases will give some measure of rust protection, but a product specifically developed for rust prevention will make the job easier, give more reliable, longer-lasting protection, and cost less in the end.



There are 18 grades of Stanorust and "SR" rust preventives—each has specific uses and advantages. Some of them were specifically made to meet U. S. Government specifications. If you have a problem of rust prevention on:

stock in storage, parts in production, or complete machines to be shipped or stored, let us help you pick the grade or grades of Stanorust you need—and make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois. Your questions will be answered or referred to the Lubrication Engineer nearest you for handling.

Gasoline Powers the Attack . . . Don't Waste a Drop!

STANORUST GIVES COMPLETE RUST PROTECTION *PLUS* THESE ADVANTAGES

1. Easy application. Because Stanorust is available in grades for spraying, swabbing, or dipping, and for hot or cold application, you can choose a product that is easiest to apply under your present conditions.

2. No waste. The wide choice of grades also makes it possible to apply the exact film needed to give the protection which the job requires.

3. Does not crack or peel. Stanorust does not harden or form a paint-like film which will be chipped off or damaged in handling.

4. Easily removed. Most grades of Stanorust can be removed by wiping the parts clean with a cloth dampened with petroleum solvent.

5. Acts as a lubricant. It is not necessary to remove Stanorust from parts that are to be assembled in a complete machine. Stanorust, itself, acts as a lubricant.

6. Light color.

7. Noninjurious to workers.

8. No unpleasant odor.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

★ LUBRICATION ENGINEERING

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Make Plans Now to Meet More Severe Water Conditions

More Corrosion Resisting Alloys Available

The problem of water pollution by sewage, chemicals and industrial wastes, which already is a serious factor in the operation of power plants, will be worse in the future. As population centers increase and American industry expands with the development of new products and processes, still more mills, factories and shops will be built. As chemistry continues to play an increasingly important part in industry, there will also be a greater number of chemical and process plants. Since most plants are located on harbors, estuaries, rivers and inlets from which power plants draw water for their surface condensers, the power plant engineer is most vitally concerned with water pollution.

Many communities are accomplishing much in sewage processing, and a number of manufacturers are treating and controlling industrial wastes. However, it is not likely that all water pollution problems will be completely solved so far as power plants are concerned. Fortunately, corrosion research and better manufacturing methods have led to the development of new and better condenser tube alloys with superior corrosion resistance. Alert power plant operators, in anticipation of more severe polluted water conditions in the future, are investigating the newer alloys.

Causes of Tube Failure

Brackish waters polluted by sewage and industrial wastes have always constituted a serious condenser tube problem. Examination of some of the specific factors involved when condensers operate under such conditions reveals why ordinary alloys fail prematurely. Roughly, these factors may be said to come under one or more of the following categories:

1. Chemical
2. Mechanical
3. Organic

From the chemical standpoint take, as an example, manufacturing plants which discharge an excessive amount of acid wastes into water which is not sufficiently diluted. Acid content of the water can be quickly raised to a point where pit corrosion will be greatly accelerated in the condenser tubes through which such water flows. The presence of chlorides or sulphates in the water will have the same effect.

Under the heading of mechanical factors would come cinders, sand, mud, wood, stones, or other small particles, which are very likely to cause deposit attack as they lodge in various parts of the condenser tubing. On the other hand, large pieces of foreign matter may lodge in the tubes, causing turbulence at those points with resulting impingement attack.

With sewage and organic wastes, hydrogen sulphide, carbon dioxide, ammonia, and nitrogen can cause excessive corrosion and pitting.

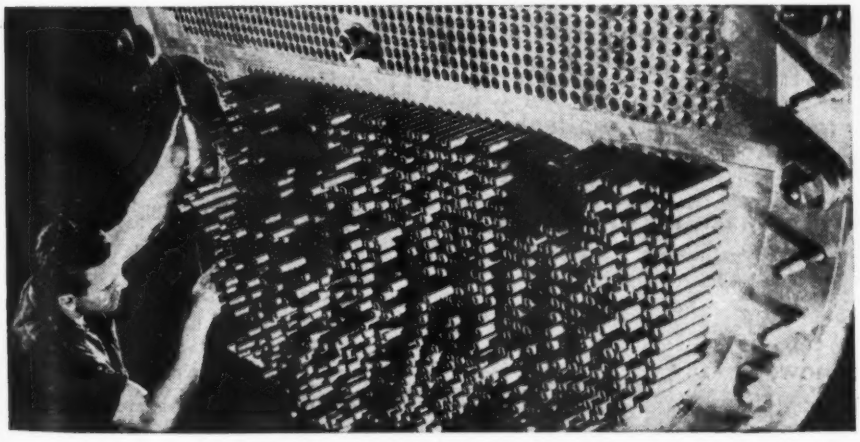
Tests Prove Duronze IV Superior

For some time the superiority of DURONZE IV condenser tubing under such conditions has been recognized. This alloy has been tested side by side with Cupro Nickel, Aluminum Brass and Admiralty by a seaboard power station using brackish water polluted by industrial wastes and decomposed sewage. At the end of nine months both the Admiralty and the Aluminum Brass were severely attacked by pit corrosion and were considered as unsatisfactory for service. The samples of DURONZE IV and Cupro Nickel were left on test for eight months more. After a total of seventeen months' service the Cupro Nickel had thinned to a marked degree and in some places was pitted through. The DURONZE IV showed very little effect and was still in excellent condition after this severe test. DURONZE IV is excellent for seaboard power stations, outlasting both Aluminum Brass and Admiralty. It is especially recommended for tropic waters too severe for ordinary alloys.

Make Plans Now

To help power plant operators who anticipate more severe conditions we will gladly send our Condenser Tube Manual which contains specifications for modern condenser tube alloys, corrosion research data and helpful information.

Be sure to write for your copy. Our laboratory will be glad to help you with problems of excessive tube failure or in planning for the future.



7800 Sq. Ft. Welded Steel Surface Condenser

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

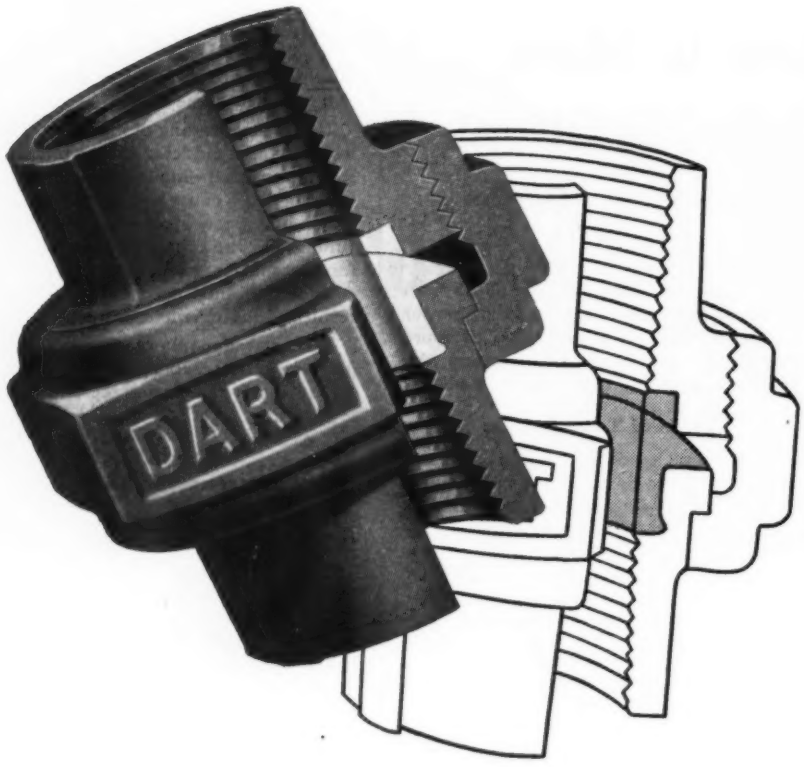
BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

ESTABLISHED 1865

DEFINITION OF A DART

TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT



TWO bronze seats, ground to a true ball joint defines just one union — Dart. In other words, Darts are different. The super-smooth seats join without jamming; part without having to pound them. Dart bodies and nuts are of high-test, air-refined malleable iron — are practically unbreakable. That's why Darts can be used *over and over again,* reaching lowest cost levels through *length of service.*

Order Darts from your supplier now, and *see* the difference.

DART UNIONS

E. M. DART MFG. COMPANY, PROVIDENCE 5, R. I.

deg and a 0.15 coefficient of friction, brushface pressure on the commutator is 1.1 times tension-spring pressure. If coefficient of friction increases to 0.45, brush-face pressure on the commutator is only 0.925 times tension-spring pressure.

Brushes may be operated satisfactorily, at either leading or trailing angles provided brush-holder design and adjustment are correct and brush angle adapted to direction of commutator rotation. Best practice, however, generally uses certain grades of soft graphite brushes only in a leading position to prevent tendency to side wear. Trailing brush operation is preferred for most industrial motors and generators that have brush holders designed primarily for trailing position operation, which can be adjusted to approximately 15 deg from the radial. However, if holder design permits operating the brushes at a 30- to 37.5-deg angle, leading operation is usually favored.

Optimum practice on units of small dimensions and high speed is not so clearly defined. There are many examples of successful operation at 30 deg leading angles on commutators of relatively small diameter at speeds as high as 9000 to 10,000 rpm. On the other hand, some tests indicate that quieter operation is obtained at these high angular velocities, with brushes at a trailing angle of 5 to 7.5 deg and a small bevel at their top ends to hold them against the trailing side of their holders. Many small machines operate successfully with radial brushes particularly where ratio of brush thickness to commutator diameter is relatively large.

Replacing Old Pumps

(*Continued from page* 73)

the suction nozzle to pick up the incoming stock.

Among the most important pump changes is the shift from engine-driven reciprocating to motor-driven centrifugal units. Not only are modern pumps more efficient but a change to motor-driven designs frequently means elimination of costly boiler plants, substitution of automatic for manual control and increase in pumping capacity without expanding the pumping station.

Reciprocating pumps in good condition have high efficiency, but steam-driven units exhausting to atmosphere may be expensive to operate. Here, economic reasons are just as favorable for replacing them with motor-driven

NEW MOVIE EXPLAINS THE

Gas Turbine

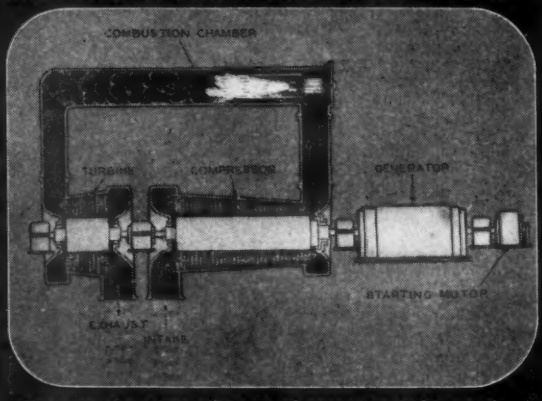
Now—for the first time in simple, everyday terms—Businessmen and Engineers can get the complete history, development and operation theory of the Gas Turbine in Allis-Chalmers new, sound motion picture, "Tornado in a Box".

ALLIS-CHALMERS
MILWAUKEE

Tune in the Boston Symphony, Blue Network, every Sat. Eve.

HERE ARE SCENES FROM A-C'S NEW MOVIE "TORNADO IN A BOX"

"Air inside the humidor expands after heat from the blow-torch increases its pressure. Then we can put it to work."



"Here are the prime elements of every gas turbine cycle — starting motor, compressor, combustion chamber and turbine."

"Let's see how the cycle works in terms of temperature. This represents temperature, and here is the entropy scale."

16 MM. PRINTS FREE

Film runs 28 minutes. 16 mm. prints available for loan — to be used on *sound projectors only*. Fill in and mail coupon to Allis-Chalmers, Milwaukee 1, Wis.

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YARNALL-WARING COMPANY
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YARWAY STRAINERS

reciprocating or centrifugal pumps as for replacing an outmoded centrifugal pump.

In hundreds of instances modernizing pumping equipment has resulted in large savings. The water department of a midwestern town operated at a deficit each year. By replacing its old pumps with motor-driven centrifugal units the city reduced water rates 15% and in 6 years built up a reserve fund of $11,000 and saved $38,000 in pumping costs. On another city-water system a new pump paid for itself in six months in reduced power and operating costs. During four years' operation repair cost was practically zero.

Frequently, replacing old pumps increases pumping capacity at no extra operating cost. One city's waterworks pumps that were over 20 years old were supplying water at a reasonable cost. However, improved efficiency of new pumps that replaced them made it possible to handle 1,000,000 gal of water more per day than the old ones had at the same operating cost.

Many industries, such as paper mills, afford just as attractive opportunities for large savings in power costs as do city-water systems. One large paper mill replaced seven old pumps with six new ones. To drive the old pumps required 320 hp compared to 159 hp for the new ones. This saving amounted to $3700 reduction in annual operating cost.

In another paper mill a pump was not delivering all overflow from the pulp-processing blanket to the all-save-screen to be reclaimed. About 250 gpm of water and pulp were going to the sewer. Replacing the old 450-gpm pump with a 700-gpm one doubled amount of pulp reclaimed, but required no increase in power. Saving amounted to $2400 per year, an impressive argument for buying a pump to fit the job.

While some pumping developments, such as shifting from engine to steam-turbine or electric-motor drive, have been spectacular, improvements in pump design to produce more compact and efficient units at lower initial cost have been steady and far reaching. This has been particularly true of centrifugal-pump design for the last 25 years. Contributing to this are improved impellers, casings, and suction and discharge passages, made possible by extensive laboratory and shop tests.

Electricity in U. S. Mines. Our mines have 50,000 miles of electrical haulage—more than the total for electrical railroads and street railways.

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FOR SAFETY AND LONG-TIME SERVICE

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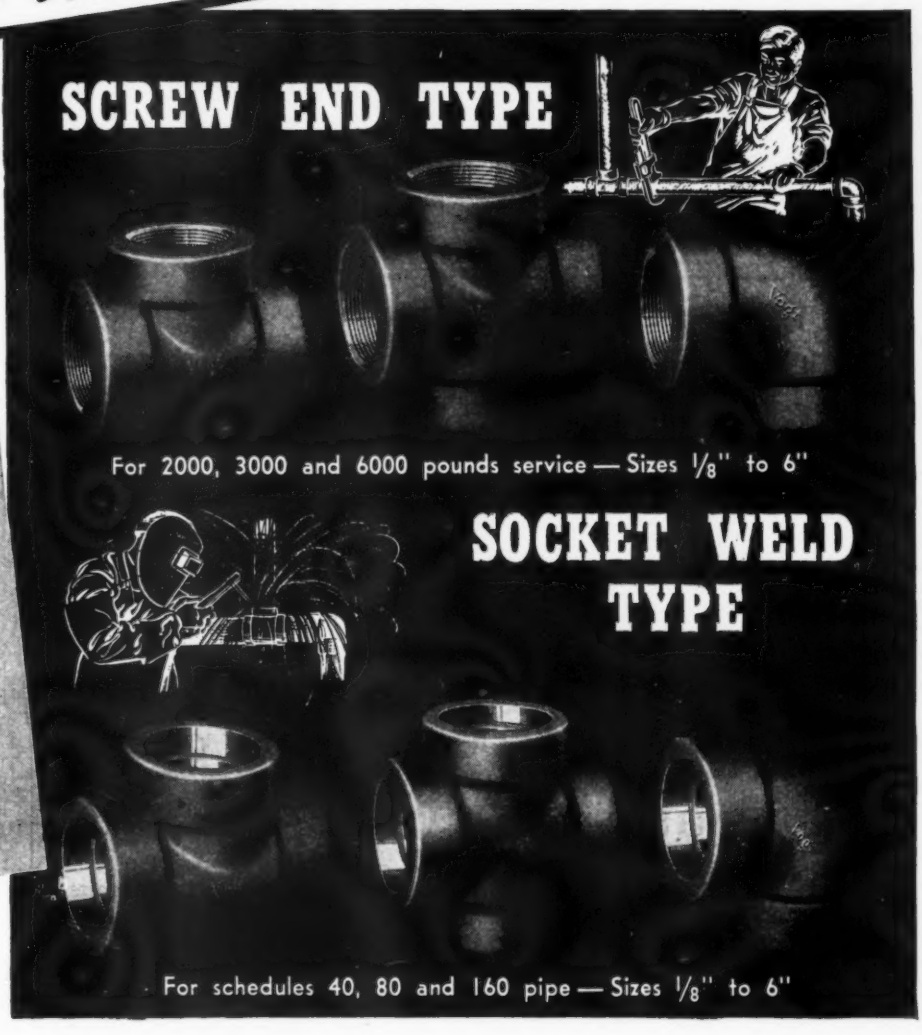
Vogt

DROP FORGED STEEL FITTINGS


SCREW END TYPE
For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"
SOCKET WELD TYPE
For schedules 40, 80 and 160 pipe — Sizes 1/8" to 6"

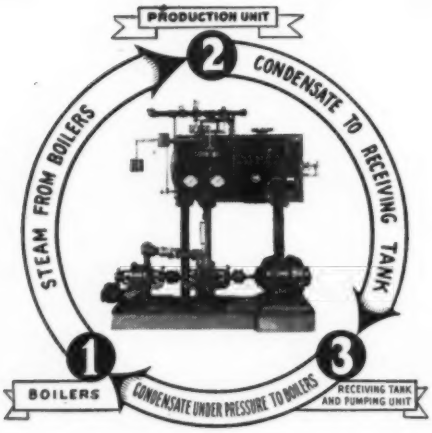
Round-the-clock operation of oil refineries, chemical plants, steam plants, etc., essential to the continuous flow of war products to the United Nations, is all in the day's work for these fittings. Today, as in peacetime, Vogt drop forged steel fittings make a major contribution to the efficient functioning of pipe lines in plants vital to the war effort.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy.

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KY.

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS



15 to 20 per cent. increase in boiler capacity obtained with 15 to 20 per cent. decrease in fuel consumption, besides reduction in maintenance and development of production volume will be as desirable in peacetime operations as in war's emergency.

Here is what a Stickle Differential Drainage and Boiler Return System will do and why it obtains the results enumerated: 1. Returns condensate from processing units to boilers, under pressure, at temperature only 15 to 20 degrees lower than temperature of steam at operating pressure—saving fuel and increasing boiler capacity. 2. Supplies positive and correct drainage—assuring maximum production from processing units. 3. Eliminates high velocities and reduces scale—decreasing maintenance costs for both boilers, steam lines, traps and other equipment.

Canning plants, laundries, milk drying plants and paper board mills are examples of types of industry in which this Stickle System is getting results. Bulletin No. 250, mailed on request, gives complete data.

OTHER STICKLE EQUIPMENT: Stickle Open Float Steam Traps, in series designs and sizes for all services—Bulletins Nos. 115, 315 and 515. Stickle Regulating and Reducing Valves, single seated and double seated series, in sizes small to large—Bulletins Nos. 235 and 435. Stickle Open Coil Feed Water Heaters, deaerating and non-deaerating types, sizes to meet your requirements—Bulletin No. 117.

Stickle

STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

SPECIALIZING FOR 40 YEARS IN REDUCING THE COST OF STEAM

Power for Peru

(*Continued from page* 91)

these, 251 were hydro, with 145,420 kw; 316 were diesel, with 34,594 kw; and 20 were steam, with 39,731 kw.

When diesel engines and small generators and motors again become available, it is generally believed that there will be a sharp increase in small power plants, as studies show there are scores of communities without adequate electric service. A 2380-kw plant recently completed near Arequipa doubled the power available to that community.

Typical of the many hydro projects to be expected in mountainous Peru, the Autisha dam, now being built on the Santa Eulalia River, 50 miles east of Lima, deserves special mention because of its unique construction. It is designed to absorb earthquake shock and for this reason is split from top to bottom in line with the direction of current flow. The halves are designed to be able to move back and forth, without damage to the dam, should nature take a notion to start shifting the mountains around.

At the point chosen as the dam site, the Santa Eulalia River pours through a crack in the mountain made, apparently, by some old seismic disturbance. This irregular crack is about 1300 ft long, 500 ft deep and from 18 to 65 ft wide. In the river bed, at the bottom of the gorge, a solid block of concrete has been poured. It goes down to bedrock some 55 ft below the river bed and rises between the rock walls to a height of 90 ft. The cross-section of this plug in the gorge is roughly quadrangular.

Above this foundation the dam proper is being built in the form of two butterfly-shaped columns each 216 ft high. At the center where these two sections would normally meet, there is a space 6 in. wide and 10 ft long. This interstice is the key point of the dam design. In the event of an earthquake it will permit the two halves to vibrate without cracking.

To close this opening and keep back the water, two obstacles have been interposed: Down the length of this aperture on the upstream face of the dam, a 10-in. iron pipe is suspended. It is filled with concrete and water pressure presses it against the 6-in. crack. It rests against two I-beams set vertically in the dam face. Halfway through the 10-ft crack there is a shaft or well a little over three feet in diameter. On the downstream side of this well there is suspended a v-shaped cop-

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Hundreds of plants have already modernized costly, inefficient boiler plants with TODD oil and gas burning equipment. *They report fuel savings up to 10% and more, with corresponding power increases.*

Operating economies like these are not unusual. For the over-all efficiency of the modern TODD burner, reflecting 30 years of sound engineering achievement, means *steam production at minimum cost*—a dollars-and-cents reason why NOW IS THE TIME TO MODERNIZE WITH TODD.

TODD combustion engineers are specialists in the modernization of industrial and commercial boiler rooms of all types. Why not call on them today . . . for an impartial survey of *your* plant . . . for suggestions, specifications, estimates. Their services are available at any time, without obligation.

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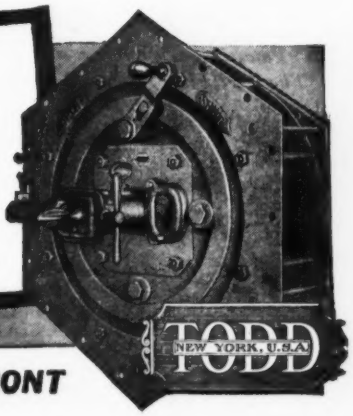
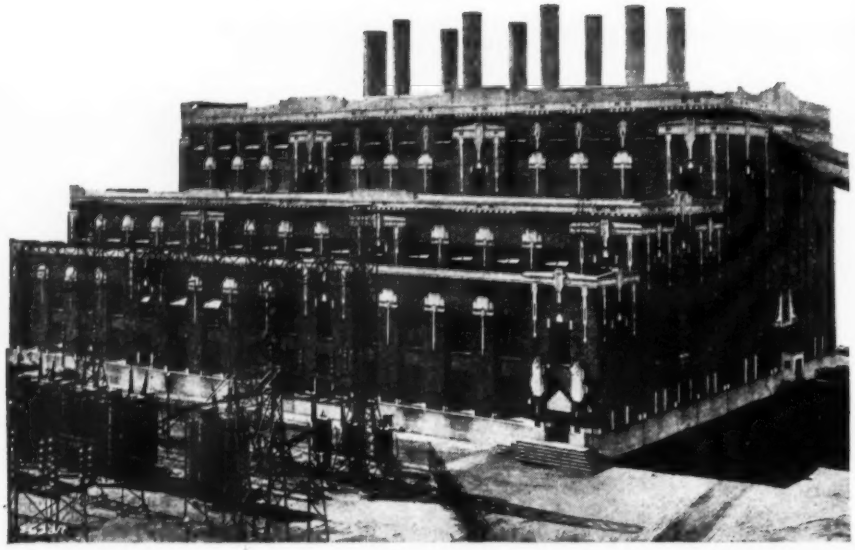


ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

For the modern POWER PLANT



Buell (van Tongeren) Dust Recovery Systems

• THIS POWER PLANT has a total generating capacity of 111,000 KW, including 37,500 KW from a new turbo generator served by a 400,000-lb.-per-hr. Combustion Engineering boiler. The boiler, fired with pulverized coal, develops steam at 875-lb. pressure and 900° F.

The 32 Buell (van Tongeren) cyclone flue dust collectors installed with this new boiler have proven satisfactory under actual operating conditions, giving high collection efficiency and requiring no maintenance during the two years they have been in operation.

Power plant engineers are invited to write for the interesting, illustrated book— "The Buell (van Tongeren) System of Industrial Dust Recovery." Ask for Bulletin G-842.

BUELL ENGINEERING COMPANY, INC.
10 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

buell
DUST RECOVERY SYSTEMS

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

per sheath forming an expansion joint and closing the crack. This flexible sheath will prevent passage of any water which may seep past the suspended 10-in. pipe and the shaft will provide a passage for the inspection of the dam's interior.

A diversion tunnel nearly two miles long will bring water under a head of 915 ft to the power station in the valley below. The dam is being built in two sections, the first to rise some 256 ft above the river bed to impound 1,500,000 cubic meters of water and the second stage to 328 ft, to impound 9,000,000 cubic meters. When completed the plant will have 30,000-kw capacity.

Designs for the dam were carried out by the Motor-Columbus Co of Baden, Switzerland, in collaboration with Prof A Stucky of the School of Engineers of Lausanne. Total cost, including the two stages of construction and necessary connecting highways, is estimated at between five and six million dollars.

Service Group Studies Engine Development

Entire service organization, in groups of about 15, was brought to Cooper-Bessemer's Mount Vernon, Ohio, and Grove City, Pa., plants for up-to-the minute information on developments in engineering and manufacture of firm's diesel and gas engines and compressors. Each group spent two days at each plant.

The field service crew consists of 63 men representing 15 branch offices of the concern throughout the country. During their visit, the service men were guided and advised by company engineers and technicians so as to become thoroughly familiar with all latest advancements in engine design, erection, installation and repairs.

Gas-Turbine Movie Available for Groups

Gas turbine makes its motion picture debut in a film, entitled "Tornado in a Box," explaining the unit's development and operation. Story of the gas turbine is unfolded in a manner that makes its principle readily understandable to the largest possible audience that could be interested in potentialities of a new prime mover. At the same time, the film frankly indicates that a great deal more of the tremendous engineering effort already applied must still be put into gas-turbine development before such potential success can be achieved.

Allis-Chalmers Mfg Co, Milwaukee 1, Wis, is loaning the film, which contains no advertising, free to any industrial or engineering group interested in showing it. Permanent prints may be purchased. It is a 16-mm film for sound projectors only.

"HOW ARE ROSS COOLERS DESIGNED TO MASTER *Any* HEAT REMOVAL PROBLEM?"

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"CP" & "BCF"
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"All parts are standard, yet specially assembled to meet individual performance needs. The "CP" design is for larger cooling requirements, and the "BCF" for smaller. Both have exceptional provisions for easy maintenance, mounting in any position and diversified piping arrangements. The construction is strong and compact — requiring minimum space.

As a result of such flexibility, they are effectively used in a very broad list of services including: lubricating oil of engines, gears, turbines and machine tools; oil pump systems; cutting oil; quenching oil; transformer oil; hydraulic presses; engine jacket water; refrigerant emulsions; small vapor condensers; and wherever oil, water or other fluids are circulated for heat removal."

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Fully illustrated. Complete data on design features, sizes, materials and performance. WRITE FOR EITHER OR BOTH!

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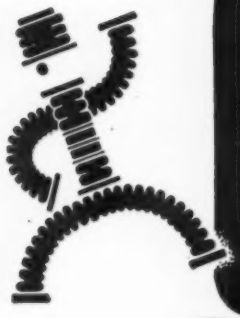

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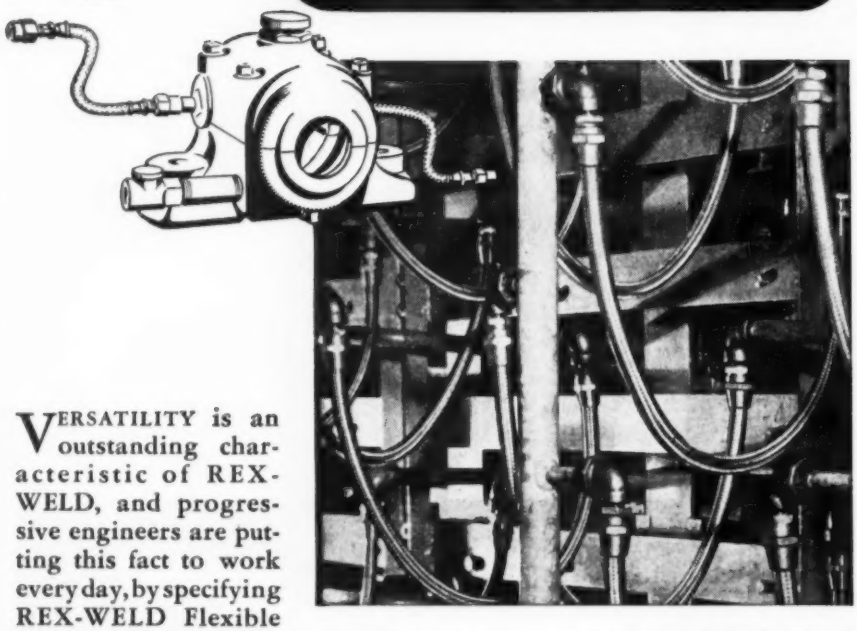
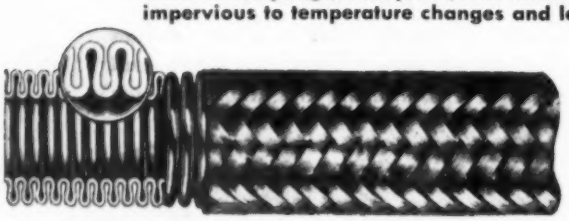


VERSATILITY is an outstanding characteristic of REX-WELD, and progressive engineers are putting this fact to work every day, by specifying REX-WELD Flexible Metal Hose wherever top-quality connections are required. From water cooling lines on precision pillow blocks . . . to "looping the loop" on big platen presses . . . this C.M.H. product is solving problems with high efficiency in practically every industrial field. Check the features below, and see how REX-WELD can provide *better* connections on *your* particular job. Our engineering department will be glad to give you complete information.

- **Withstands high pressures and temperatures.**
- **Seep-proof to gases and liquids. Rust-resistant and non-deteriorating.**
- **Extreme flexibility, uniform wall thickness.**
- **Non-collapsible and non-kinking.**
- **Long mill lengths.**
- **Rex-Tite Couplings, heat-proof, with metal-to-metal seat, impervious to temperature changes and leakage.**



Rex-Weld Hose, braided, available with annular or helical corrugations.

Flexible Metal Hose for Every Industrial Use

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MAYWOOD, ILLINOIS

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Report on Recent DEMA Meetings

At a recent Diesel Engine Manufacturers Association luncheon, in New York City, 26 instructors of diesel engineering discussed with 17 engine builders the problem of turning out for industry better-trained diesel men.

Ralph Miller, chief engineer of development and research, Worthington Pump & Machinery Corp, declared that American engine builders had to look to foreign countries for most of their designers. Prof Neil P Bailey, Rensselaer Polytechnic Institute, pointed out that American boys get higher salaries in fields other than designing. Gordon Lefebvre, president of Cooper-Bessemer and chairman of the meeting, added that in Europe designers generally receive more credit and prestige. Massachusetts Institute of Technology's spokesman, Prof C Fayette Taylor, said that the films and slides some manufacturers offer the schools are too elemental and sales-slanted. What they need are actual test data on engine performance, showing air consumption, fuel consumption, etc. They can then compare theory and practice.

Manufacturers agreed that the most useful graduate engineer is the man with a broad, basic education in mechanical engineering, with enough machine designing and shop work to understand the nature and operation of a diesel engine. Specialization in diesels fits better into the post graduate picture.

Harvey T Hill, DEMA's executive director, foresaw a government diesel surplus at war's end amounting to perhaps a billion dollars. Any assumption that the way is all cleared for allotting engines to schools that need them is premature.

Problems facing the diesel engine industry were considered at a round-table discussion at the annual one-day meeting, Dec 6, of the DEMA at Cleveland, Ohio. Engine builders, assembled at Hollenden Hotel, talked over best way of disposing of anticipated surplus of engines at end of war, how to improve quality of diesel instruction in colleges and universities, and ways of dealing with legislation affecting the industry which may be proposed in early 1945.

Following were elected officers of DEMA for 1945; president: R E Friend, Nordberg Mfg Co; vice-presidents: F H Kilberry, Atlas Imperial Diesel Engine Co, and E J Schwanhausser, Worthington Pump & Machinery Corp; Treasurer: Robert H Morse, Jr, Fairbanks, Morse & Co. Harvey T Hill continues as executive director.

Four new directors were named as follows: Norris H Schwenk, Busch-Sulzer Bros Diesel Engine Co, Charles E. Brinley, Baldwin Locomotive Works, Charles G Cox, Enterprise Engine & Foundry Co, and F H Kilberry.

George W Codrington, general manager of General Motors' Cleveland diesel engine div, escorted association members in a tour of the factory over which he has supervision. Association did not have outside speakers this year as session included only bare essentials.

THE WORLD'S *fastest complete* BOILER TUBE SERVICE

• Experienced fabricators of tubes for all types and sizes of boilers—We have both the capacity and facilities for handling orders in dozen or carload lots quickly. For accuracy—for uniformity in each length, in every bend—write—wire or phone your next order to Boiler Tube Company of America.

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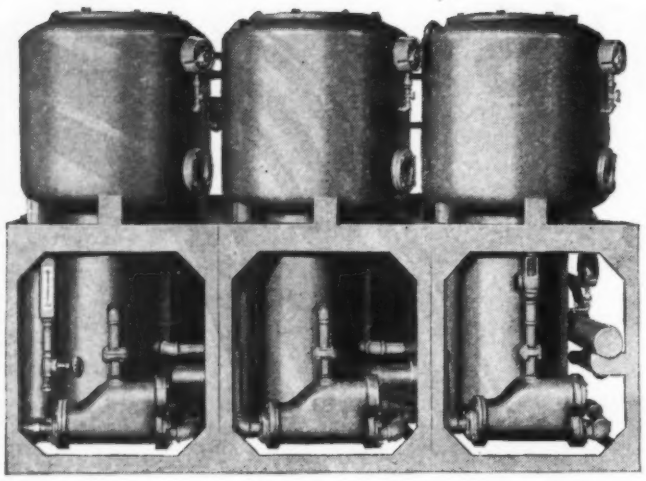
FRED S. RENAULD & COMPANY, Los Angeles



PURE WATER

Water is perhaps the most abundant raw material in the world, but the chemical makeup and quality of most existing supplies is oftentimes improper for the intended use of the water.

HENSZEY *Distillation* SYSTEMS

can deliver an abundance of absolutely pure water with a saving of half the fuel necessary to achieve the same results by means of conventional distillation equipment. Henszey units can be built in any desired capacity from 3,000 to 50,000 pounds per hour in one single compact unit. They can be fabricated from steel, stainless steel, monel, copper or combinations of above for specific use.

Send for new bulletin—just off the press.

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Watertown • Wisconsin

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FOOD PROCESSING

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MANUFACTURING

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POWER PRODUCTION

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HUMAN CONSUMPTION

HENSZEY

DISTILLATION SYSTEMS

Continuous Blowdown • Heat Exchangers • Boiler Feed Regulators
Feed Water Meters • Flow Indicators • Proportioning Valves

New Equipment

(*Continued from page* 130)

opening them. Tool locks in either position. This arrangement leaves operator's hands free to handle the work. With the 6-in. jaw opening set as required, piston stroke can be adjusted within a 1-in. range to vary the operating speed, and any holding pressure from zero to 2½ tons can be provided by regulating air pressure. Unit does not interfere with hand operation of the vise. *Bellows Co, 3334 Prospect Ave, Cleveland, Ohio.*

Insulated Brush

BRUSH CLEANS around electrical apparatus in power plants and substations. Handle, 3 ft, has hand guard to protect user from slipping and possible contact with current. Brush section is 11 in. *Industrial Products Co, 2820 N 4th St, Philadelphia 33, Pa.*

Worm-Gear Speed Reducer

FORCED AIR-COOLING, as employed in *De Laval* fan-cooled unit, is said to remove heat so effectively that gear capacity is doubled for practically all ratios and sizes at 1750 rpm. This permits smaller, lighter and less expensive speed reducers, without sacrifice of efficiency or durability.

Fan, mounted on worm shaft, draws air at high velocity over and around heat-dissipating ribs upon air side of oil reservoir housing the gearing. Use of a double wall greatly increases effectiveness of the cooling by confining cooling air to housing and thus securing close air-to-metal contact necessary for maximum heat transfer. *De Laval Steam Turbine Co, Trenton 2, New Jersey.*

Safety Valve

INLET VENTURI TUBE NOZZLE of safety valve gives a clear, unobstructed port and guided high velocity of the steam, which results in high lift and correspondingly great capacity. Patented separator bell causes steam to make three changes in direction before passing into atmosphere and

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THIS ANSWER

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

THESE REASONS!

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of Failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

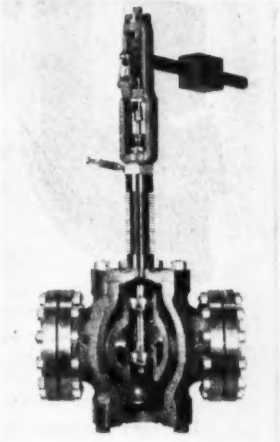
Type 1000-HP normal size diaphragm. Made for delivery pressures over 30 lbs.

Type 1000-LP has large diaphragm. Made for delivery pressures under 30 lbs.

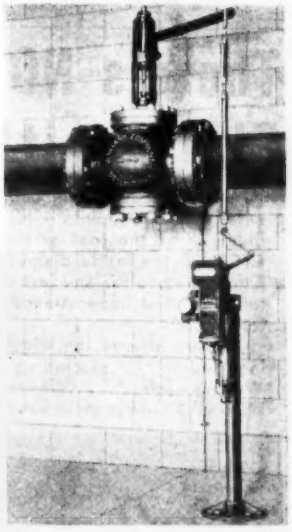
CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Balanced Valves, Series 42, have no lost motion. Have roller guides that kill side strains; stop packing trouble. Practically no maintenance. Sizes ½" to 12"; pressures up to 600 lbs. temperatures to 800° F. Bodies: iron, bronze, steel; all standard trims. With Air Cooled Packing Box (42-AC-R) shown above; or water cooled; or no cooling box. Made also with center guide. Bulletin 965.



The Cash Standard Type 100 Controller above is operating an 8" Type 42-R Balanced Valve, automatically reducing 250 lbs. down to 125 lbs. pressure, handling 200,000 lbs. steam per hour.

Type 100 Controllers have lots of operating power, enough for any size valve; are fully compensated; have adjustable range; are very sensitive. Bulletin 963 covering the Controller and Bulletin 965 covering the Valve give complete and interesting details. Write for them.

JEFFERSON

Specialty
UNIONS
with the
Recessed Brass Seat

Save Time, Space and Cost on Any Job

90 Union Elbows are but one of many types of Jefferson Convenience Unions which help assure economy and eliminate unnecessary pipe joints. They help solve difficult piping problems.

All Jefferson Unions—Standard or Special—are available with the exclusive Jefferson Recessed Brass Seat. This feature provides a seat which is practically one piece with the iron and which is not exposed to contact with pipe ends and therefore cannot be dislodged when pipe is screwed too far into the body of the union.

Full information on Jefferson Unions is available promptly on request. Consult us or your nearest distributor.

JEFFERSON UNION CO.
601 WEST 26th STREET, NEW YORK 1, N. Y.
Factories at
LEXINGTON 73, MASS. **LOCKPORT, N. Y.**

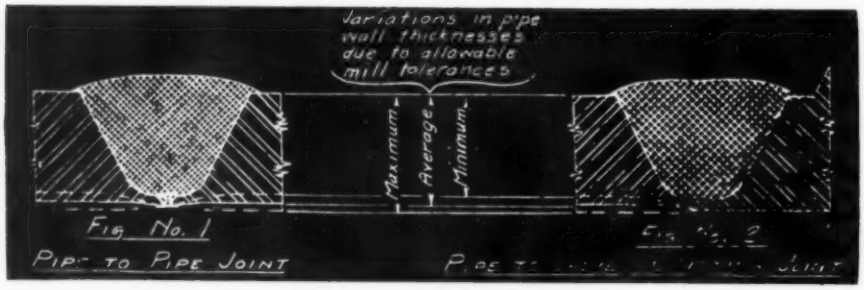
There's NO CONSTRICTION in pipe FLOW with this Welded Joint!

Why? Because, with the Westport Patented Welded Joint, reduction in inside diameter at the root of the weld NEVER EXCEEDS the inside diameter of the pipe if furnished to the smallest internal diameter permitted under standard commercial tolerances!

You are assured the latest in power piping design . . . including the Westport Welded Joint . . . when you engage Mitchell & Company to handle your piping.

Specifically, the Westport Joint allows complete penetration to the root of the weld . . . smooth pipe contour at the base of the weld with no "icicles" or "protrusions" . . . no gaps between rings and the inside pipe wall . . . greater flexibility in alignment of pipe, valves and fittings.

It will pay you to write today for details and full information contained in the free bulletin we offer you. Write for it without delay.



Illustrated above is the Westport Method . . . consisting of the use of a joint in which the ends to be welded are formed and machined to provide a special U-shaped groove . . . joining the lips at the root of the weld by the oxyacetylene process . . . and completing the joint by the usual electric arc procedure. *Write for Bulletin and Full details.*

W. K. MITCHELL & CO., INC. Philadelphia 46, PA.

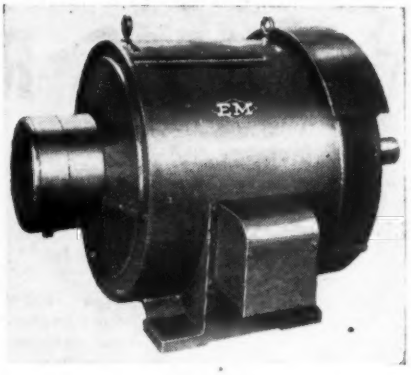
1899 1944

includes a drain for the condensed moisture into the body. Escape of vapor into the air is thereby minimized. Separator bell also helps to keep spring cool by preventing steam from striking the spring. It also improves freedom and maintenance of alignment by providing for higher support of the spring than in other designs.

Correct alignment of the stem is further maintained by precision machine work throughout valve and by top guidance of stem in two bearings, instead of one or three as employed in other designs. Maker claims this 2-bearing construction eliminates angular distortion, minimizes fouling of guiding areas and provides maximum maintenance ease, besides assuring greatest accuracy of reseating. *Farris Engrg Co, Palisades Park, N. J.*

Welded-Seam Tester

KANO KROIL tests welded seams on steel tanks that must be absolutely tight. By spraying a thin film along the seams, it penetrates to the opposite side of the seam if there is even a minute opening. It is a creeping, penetrating chemical with a low surface tension so that it spreads rapidly. *Kano Laboratories, 75 E Wacker Dr, Chicago 1, Ill.*



High-Speed Generators

DRIPPROOF GENERATORS are in sizes 18.7 to 125 kva, 1800 to 514 rpm, for standard voltages, 1, 2 or 3 phase, 50 and 60 cycles, 80% power factor, 50 or 40 C rise. High-speed ac generators are supplied as 2-bearing units for belted or coupled duty, or single-bearing units for direct coupling to driving engine. Generators are also available as packaged units, with controls mounted on generator frame and wiring factory-connected. *Electric Machinery Mfg Co, Minneapolis 13, Minn.*

Constant-Level Lubricator

STYLE B LUBRICATOR offers an automatically controlled, visible oiling method for most bearings. Operation is based on physical law that all fluids seek their level. When bearing oil level falls, air is admitted into reservoir through a vent, thus automatically releasing just enough oil to restore original level.

Conveniently located single thumbscrew permits easy and quick removal of reservoir from base, replacing two spring clips on earlier models. New cement seals collar

..AS SALES MANAGER I'M INTERESTED IN BETTER VALVE MAINTENANCE

. . *It means surer, quicker deliveries!*

I don't know much about valves — but I do know that when they leak, and must be repaired or replaced, things happen to production, and my deliveries go to pot!

Since our canny engineers ordered that Dexter Valve Reseating outfit we haven't had a single shutdown due to valve leaks. And, I understand that one man operating the Dexter can *reseat* a valve, *right on the line,* in a few minutes. It used to take a crew several hours — if they could repair the valve.

They tell me we're saving big money by cutting leak losses in steam, air, water and oil, too . . . thanks to Dexter.

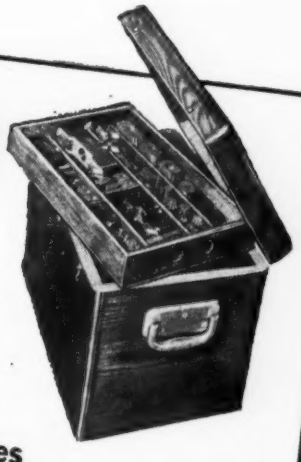
20

Drop us a line . . .

giving your toughest valve-leak story . . . make, type, size and material . . . whether water, air or steam. We'll show you how to answer your problem with Dexter equipment.

A large part of our production facilities is devoted to war work. Orders for Dexter Machines and Cutters, from firms who want this economy and efficiency, have far exceeded our non-military manufacturing facilities. Please be patient — we will deliver just as quickly as possible.

DEXTER VALVE RESEATING MACHINES AND CUTTERS for Globe, Gate and Pump Valves



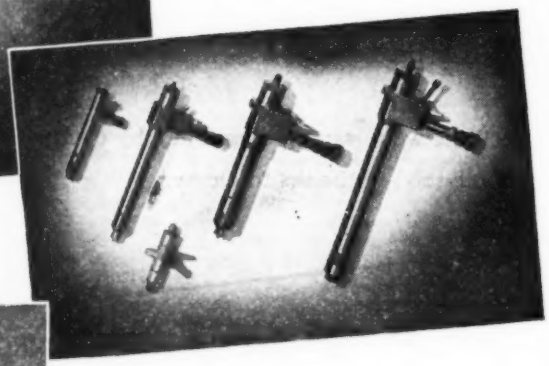
THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

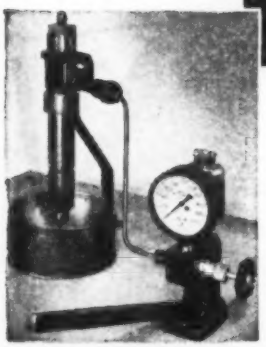
SAFEGUARD DIESEL ENGINE PERFORMANCE

with Dependable ADECO

FUEL INJECTION EQUIPMENT

Adeco equipment is engineered to secure the optimum performance of the engine you are building or plan to build. Today's line of fuel injection pumps, nozzles and nozzle holders is the most dependable in Adeco history—the result of years of pioneering and research for the diesel industry. Their performance speaks louder than words in pointing the way to the finest in diesel fuel injection equipment.





ADECO NOZZLE TESTER for LOW-COST MAINTENANCE

America's most widely used Nozzle Tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressures up to 10,000 p.s.i. Tests both large and small injectors. Avoids costly delays and possible damage to engine. Also obtainable with Navy-approved gauge. Write for bulletin.

Ideal for Testing Hydraulic Equipment

ADECO

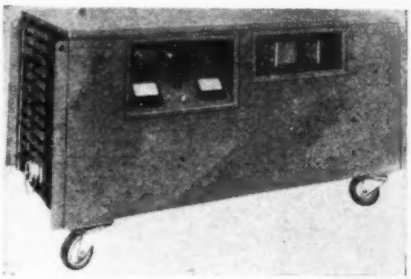
AIRCRAFT & DIESEL EQUIPMENT CORPORATION

4401 RAVENSWOOD AVENUE, CHICAGO 40, ILLINOIS

to reservoir, which is said to increase strength of bond 50% over earlier models and eliminates cracking. Style B lubricators are in five sizes, with 1- 2- 4- 8- and 16-oz capacities. *Oil-Rite Corp,* 3478 *S* 13*th St, Milwaukee* 7, *Wis.*

Forced-Draft Blower

STEAM-DRIVEN BLOWER, for cargo-ship service, has no speed-limit governor. Speed is limited by the blower, load of which increases as speed cubed. Overspeed is then impossible. It has no oil cooler and therefore needs no water connections. Blower is for vertical operation. By placing both bearings below turbine element, only one steam gland is required. This also makes it possible to lift out entire rotating element as a unit assembly with bearings. By a unique arrangement of oil chambers, no packing is needed to hold oil. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*



Rectifier Unit

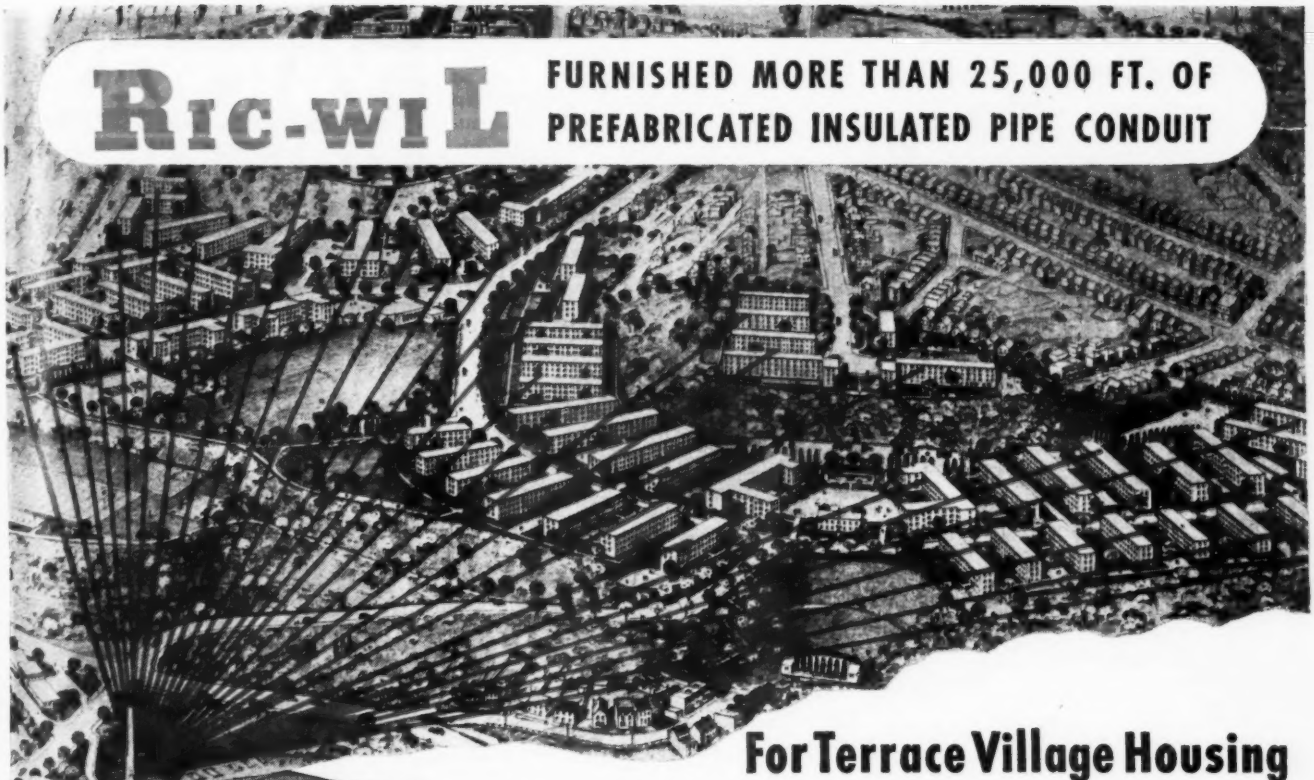
GREEN MOBILE RECTIFIER unit, for magnetic testing, is a power supply unit which has a continuous capacity of 1500 amp dc with proportionately higher rating for intermittent operation. Output voltage is adjustable in eight steps from one to six volts. Fan-cooled selenium rectifier assembly is core of unit. Deep rainproof louvers at each end provide for air intake and exhaust. Output terminals, dc, on each side, and control panel are located in cabinet-wall recesses.

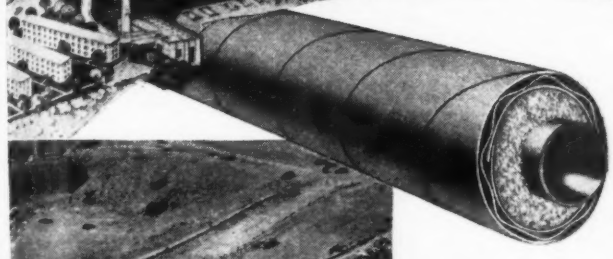
Control panel has fan starting switch, pushbuttons for main contactor control, voltage adjustment switch, pilot lamp, visual and audible overload warning signals, voltmeter and ammeter. Three-phase 440-v 25-cycle power supply is brought to unit through a 25-ft cable which plugs into a weatherproof receptacle at one end of cabinet. *W Green Electric Co,* 130 *Cedar St, New York* 6, *N. Y.*

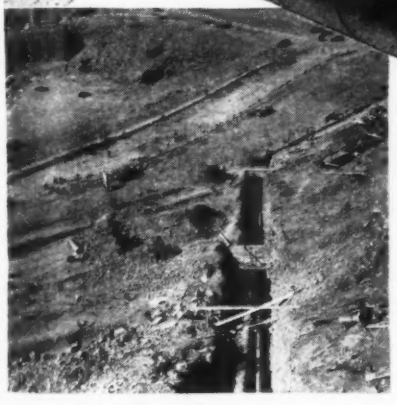
Fluorescent Lamps

SLENDER FLUORESCENT TUBES, 8 ft long, will be manufactured as soon as war conditions permit. The hot-cathode lamps will be in 42- 64- 72- and 96-in. over-all lengths, including sockets and single-pin bases at both ends. Bulb diameter ranges from ¾ in. of 42-in. and 64-in. lengths to 1-in. diameter for 72- and 96-in. lengths. New lamps will consume about half the wattage of wide standard models, per running foot of tube, and produce slightly more than half as much light per running foot, according

RIC-WIL FURNISHED MORE THAN 25,000 FT. OF PREFABRICATED INSULATED PIPE CONDUIT







Line of Ric-wiL conduit from anchor to boiler house (top, left). Note shallow, narrow trench.

Installing connector band. All necessary accessories are prefabricated and shipped with order.

For Terrace Village Housing Unit No. 2 in Pittsburgh

Fuel savings of 15% or better are made possible in this mammoth project by a central heating system. Ric-wiL pre-fabricated pipe units provide the insulation and protection for the entire underground distribution system.

A total of 83 buildings, comprising 1851 living suites, are supplied with heat and hot water from a central plant, through an underground distribution system containing over 25,000 lineal feet of Ric-wiL pre-sealed Insulated Pipe Units. High-pressure steam from the plant is piped through Ric-wiL steam conduit to six scattered stations where hot water is generated and circulated through Ric-wiL conduit to all the buildings, for heating and hot water supply. Thus the project realizes the economy of steam, and the temperature control and convenience of hot-water heating.

Any Community Can Incorporate These Advantages of Central Heating in Their Postwar Plans:

- Savings of 15% or better in overall fuel consumption.
- Elimination of furnace or boiler tending by consumer.
- Promotes cleanliness in buildings heated.
- Provides extra room in building basements.
- Decreases fire and explosion hazard.
- Reduces smoke and soot, provides cleaner, healthier, community.
- Eliminates private coal delivery and ash removal.
- Gives uniform, clean heat quickly, whenever needed.

For information about Ric-wiL Conduit for central heat distribution, get in touch with your nearest Ric-wiL agent or write to us direct for our new Catalog No. 44

RIC-WIL INSULATED CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

Combustion efficiency as applied to Boiler Plant Operation. Fuels and Equipment is now a most important factor in Defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.

The Combustion trained man—the Hays trained man—can do his part, and open up big opportunities for himself that never existed before, by devoting a little of his spare time in training himself to meet present conditions.

Just a Few of Our Hundreds of Friends

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Armour and Co. 75
Combustion Engineering Company 45
Riley Stoker Corp. 75
Iron Fireman Mfg. Co. 35
Commonwealth Edison Company 145
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and many others.

How? Through the simple, easy reading, *practical* Hays Home Study Course in Fuel and Combustion Engineering. For 26 years the Hays Institute has specialized exclusively in training in Combustion Efficiency. Hundreds of Hays trained men now hold substantial positions of responsibility. What we have done for them we can do for you, in your spare time. Many companies urge their men to enroll. They know the value of Hays Combustion Training.

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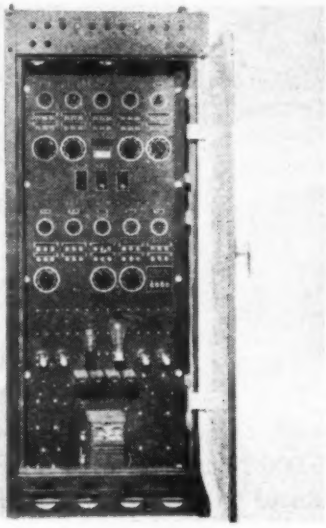
to manufacturer. They are especially designed for operation on instant-start ballast. All four lengths are designed to burn at various levels of brightness, operating on either 100 or 200 milliamperes of current. Tubes will be in standard white color only and will have same life rating as standard 40-watt fluorescent lamp. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Fabric Spat

THREE SNAP FASTENERS at top and two at bottom make spat easy to put on and adjust and assure quick removal. Elastic strap fits under instep. Large flare assures overall protection of instep. Pants may be worn over spat or tucked inside. Spat, made from a coated fabric, which is claimed to give same protection as rubber but is lighter in weight and extremely flexible, provides ankle and foot protection against acids, alkalis, oils, solvents and greases. *American Optical Co, Southbridge, Mass.*



Weld and Sequence Timer

CR7503-F170 TIMER provides various time and current adjustments necessary for welding heavy sections of air-hardenable steels. Although this weld-and-sequence timer is especially designed for use with a GE ignitron contactor and heat-control panel, it may be employed in combination with most GE spot-welding controls which include phase-shift method of heat control.

Operating from 230/460/575 v, 60 cycles, control adjusts time of current flow and its magnitude for preheating, welding, grain refinement and tempering. Other adjustments control time for chilling the weld nugget following weld and grain refinement periods. *General Electric Co, Schenectady, New York.*

Vibration Mount

DETERMINATION OF PROPER Rexon mount and its actual installation requires neither engineering skill nor alteration of equipment. Only two standard mountings are required to effectively isolate all vibration. All one needs to know is total weight, weight distribution of machine to be in-

YARWAY
INVOLUTE
SPRAY
NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

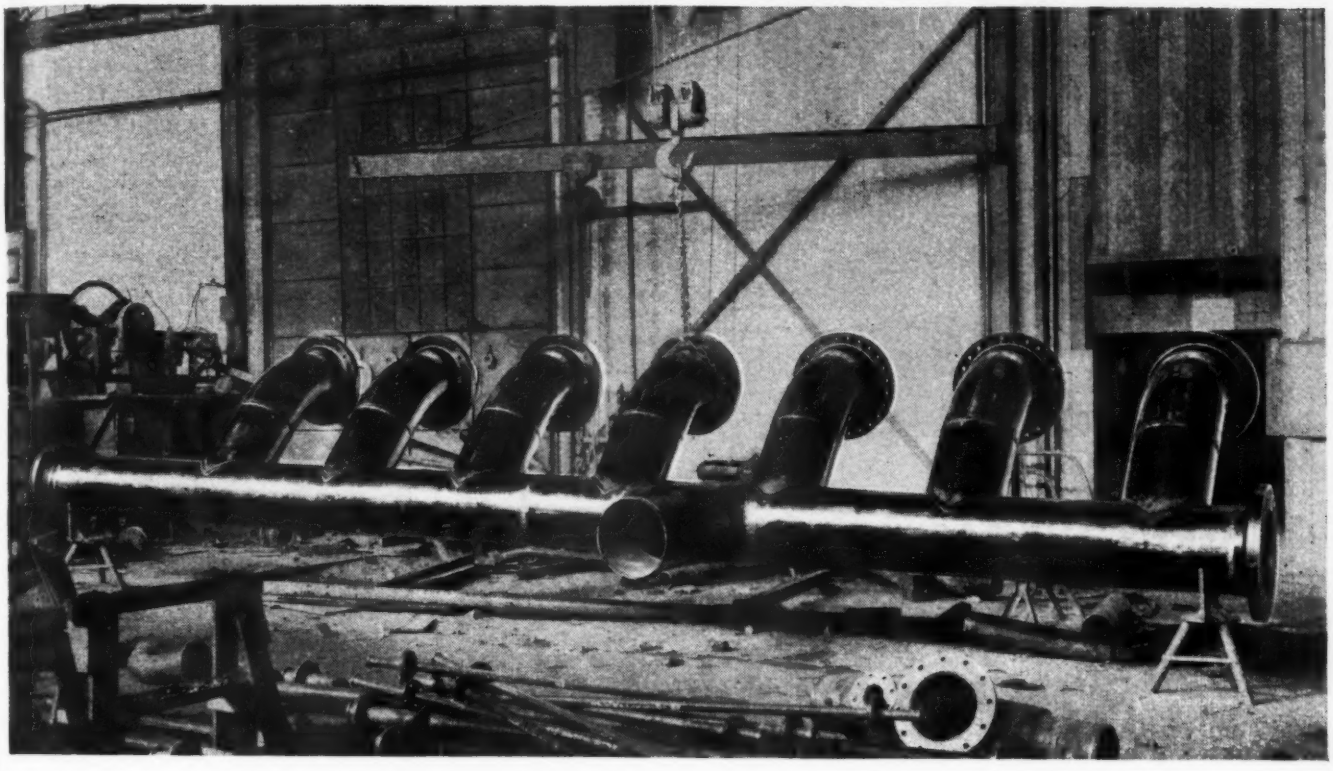
Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from ¼ in. to 2½ in. Write for Catalog N-616.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

20" O.D. Carbon Steel Distribution Manifold for Export



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Known for Depe
PRE-FABRICATIC

HERE'S THE EASIEST WAY TO SELECT AUTOMATIC *Valve Specialities*

Check with Davis!

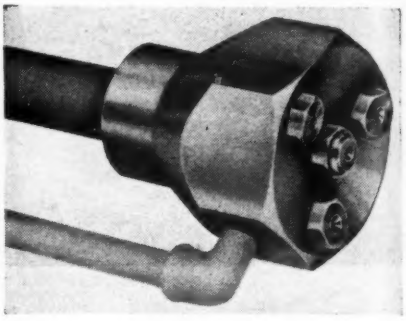
Davis offers one of the broadest lines of automatic valve specialties in existence today. Because selection of the right valve for the job can be a difficult procedure without proper data available, Davis offers a complete line of catalogs to acquaint you with sizes, material specifications, pressure ranges, physical data, and other pertinent information which will help you in valve selection for power, process, and heating jobs. There is a Davis valve for your particular problem.

CUT OUT AND MAIL THE COUPON NOW

sulated and whether direction of vibration is vertical or horizontal. Temporary or permanent overload, according to maker, cannot damage mounts. They can be easily and quickly installed without special angles, brackets or radius rods, and without increasing over-all height of machine more than 1½ to 2 in. *Hamilton Kent Mfg Co, Kent, Ohio.*

Electric Controls

ELECTRIC CONTACT CONTROLS, when applied to circular-chart electronic potentiometers, serve as an auxiliary switch for operation of signal lamps and other devices. Controllers will be available in two forms. One contains a locking-in relay for electric furnace control. It is also for applications involving use of contactors and for processes requiring a differential gap. Second design, without a relay, is for direct control of motorized valves, operation of signalling devices and for applications requiring a *dead* neutral. *Brown Instrument Co,* 4494 *Wayne Ave, Philadelphia, Pa.*



Mixing Nozzle

EXTERNAL MIXING NOZZLE, in brass, stainless steel and other materials, handles various liquid proportioning and mixing jobs. Nozzle is actually a 4-nozzle assembly with one nozzle mounted in mixing head center and three placed on 120-deg centers near outer edge. Side line feeds center nozzle while other three are from main line. Outer nozzles are set on the concave face of mixing head at an angle producing thorough mixing of four streams. Mixing nozzle uses *Fulljet* nozzles in its assembly and nozzle combinations may be varied to obtain any desired proportion between two liquids being mixed. Atomization of the liquids may be coarse or fine. *Spraying Systems Co,* 3021-*S W Lake St, Chicago* 24, *Ill.*

astic Packing

PALMETTO PLASTIC PACKING, lubricating ect is made lasting by combining aphite with flakes of soft, antifriction etal. Palmetto plastic packing is said provide exceptionally advantageous operties. Asbestos makes a strong, heat-isting bond; binder gives resiliency and ability under pressure; graphite and etallic flakes minimize frictional wear. here is no liquid lubricant to be squeezed driven out under heat, or pressure, and cking does not dry out or harden in use. service, it forms a plastic metallic bush-g around rod or shaft. Packing is for

"This is the most complete Manual on Belting I ever saw . . . yet it has only 56 pages!"

All in this one handy 56-page booklet, you'll find...

How to pick the right leather belt for the job — a conveniently-organized section on what to expect from various tannages . . . tables on how to figure belt dimensions from horsepower and speed of motor . . . further aids on figuring drives not covered by tables . . . recommendations on belt thickness and pulley size, classified by types of machine drives.

How to select between Modern Group Drive and Automatic Tension Drive (pivoted motor base).

How to select between Multiple-V-Belt and Flat Leather Belt for Automatic Tension Drive.

How to figure Flat Leather Automatic Tension Drives — useful short cuts.

How to figure prices — table on prices, another on pivoted motor base prices.

How to install your flat leather belt.

How to make your belts deliver more power and last longer.

This manual has been published for *your* convenience. Use the coupon—receive your copy by return mail. No obligation.

Make sure you know the opportunities for reduced maintenance, longer life, greater efficiency offered by the Flat Leather Automatic Tension Drive. Explained in the Manual — along with information on other types of drives.

GRATON & KNIGHT COMPANY

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WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL LEATHER PRODUCTS

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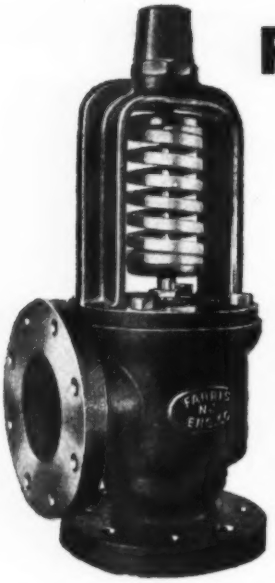
HIGH LIFT

A FEATURE OF *EVERY* FARRIS RELIEF VALVE



Farris Relief Valves are made with open or enclosed springs, and in a variety of models and combinations for all liquids and all pressures. The Farris line also includes Safety Valves, Special Valve Controls, Remote Motion Control Devices, and Strainers.

High lift . . . which means ample capacity for prompt relief . . . is provided by the oversize springs in these high-quality Liquid Relief Valves.

Moreover, the springs in Farris Valves have low fibre stress . . . low pitch . . . are mounted on flexible joints at both upper and lower points . . . are cadmium plated . . . and are carefully calibrated to avoid overstress at any point of valve operation.

These are some of the features that give you dependable operation, long life, and low maintenance expense when you use Farris Relief Valves. Write for bulletin and complete information.

Farris

ENGINEERING COMPANY

366 Commercial Ave. Palisades Park, N. J.

air, ammonia, gases, water, mild chemicals and general services at temperatures not exceeding 550 F. While not intended to replace braided or plaited packings, this plastic packing, installed in pumps, valves and on rotating shafts of steam and chemical equipment, gives highly satisfactory service. At present, packing is available for shipment in coil form in one general-purpose grade. Other grades and styles are in preparation. *Greene, Tweed & Co, 4377 Bronx Blvd, New York 66, N. Y.*

Lightweight Aprons

LABORATORY AND INDUSTRIAL aprons, made with cotton fabric and a vinyl resin coating, are in 35x45 and 29x35 in. sizes. Vinyl resin coating makes aprons waterproof, acidproof, alkaliproof, oil and grease resistant. *B F Goodrich Co, Akron, Ohio.*

Preset Interval Timer

MODEL NO. 2500 may be preset to allow a given operation to continue for almost any predetermined time limit and to close or open a circuit at end of preset time.

Following are features: (1) Setting knob is directly connected to switch operating cam. (2) All energy for operating switch is built up by manually setting pointer. (3) Switch is of single-pole, double-throw 1000-watt capacity, fully inclosed design. (4) Unit has only two exposed gears. (5) Timer has a self-starting slow-speed completely sealed synchronous motor. (6) No energy is required of clock motor to trip switch at end of preset time. (7) Model has ten time ranges, from 0 to 15 sec through 0 to 20 hr. (8) All unit parts are rustproofed and protected against corrosion. *Paragon Electric Co, 37 W Van Buren St, Chicago 5, Ill.*

Rust Solvent

CARBORUSTEX CONSISTS of several chemicals, each of which has its individual reaction upon various conditions of rusted surfaces. One of these chemicals assists in dispersing active ingredients uniformly over surface. Others attack any grease or oil that may be present so that other active chemicals can come directly in contact with the rust. Chemicals are not toxic or injurious to skin. Noninflammable solvent, applied by brush, spray or dip method,

THE recent extension to the Market Street Steam-Electric Station of the New Orleans Public Service Inc. at New Orleans, includes a 37,500 KW turbo-generator and the two-pass, direct flow, divided waterbox condenser illustrated above. Cooling surface consists of condenser tubes 22 feet 3 inches long.

The two 30-inch horizontal circulating pumps shown in the foreground are of the double suction type, each having a capacity of 19,550 GPM.

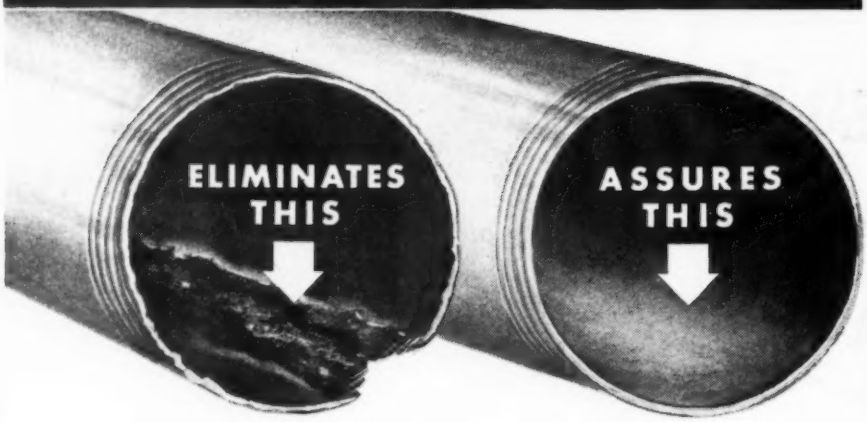
Condenser and pumps were designed and built by Foster Wheeler.

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

CORAVOL LINES BOILER *in your steam system*



STOP CORROSION WORRIES

with CORAVOL

Save costly pipe repairs, replacements, maintenance labor, hours and days of shutdown loss

EASY AND ECONOMICAL TO USE!

For seven years, **CORAVOL** has proved its value in hundreds of heating and steam power plants in more than 20 different industries.

CORAVOL (1) *prevents corrosion* in steam and condensate lines, (2) *cleans out* clogging rust deposits already present. Thus, **CORAVOL** *protects lines;* increases effectiveness of heat transfer surfaces; restores original capacity of lines and the operating efficiency of valves and traps.

CORAVOL is NOT a boiler feedwater treatment—it is designed especially and specifically for use in steam systems. **CORAVOL** *volatilizes* with the steam, *condenses* with the steam, and dissolves in the condensate. It circulates throughout your steam system and protects *all* zones from corrosive attack.

Mail the coupon TODAY for complete FREE data about the **CORAVOL** *process.*

MAIL TODAY

WESTERN CHEMICAL COMPANY
715 Washington Street — Kansas City 6, Missouri

Without obligation to me, please send complete data on the CORAVOL Process

NAME_____ TITLE_____

COMPANY_____

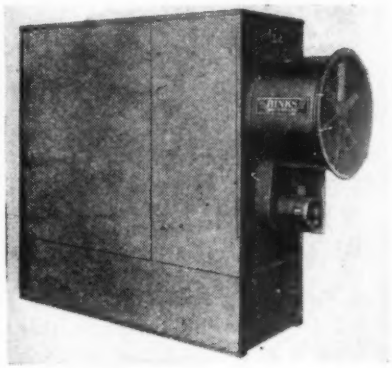
ADDRESS_____

CITY AND STATE_____

spreads readily and leaves no globules. *CarboRustex*, supplied only in concentrated form, is mixed with water in equal parts. A chemical rust inhibitor, which is dissolved in water, is furnished with *CarboRustex*. This solution rinses metal surface after rust has been removed. Inhibitor protects surface from oxidation until surface can be permanently protected with a coating. *Carbozite Corp, First National Bank Bldg, Pittsburgh 22, Pa.*

Power Transformers

PRESSED-STEEL END COVERS, instead of steel castings, are said to reduce the weight of *Acme* air-cooled transformers 22%. Overall dimensions, in some sizes, have been reduced as much as 4½ in. Redesign in no way affects rated output of the units and temperature rise remains at 55 C. New design covers all air-cooled transformers from 1 to 15 kva with primaries up to 2400 v. *Acme Electric & Mfg Co, Cuba, New York.*



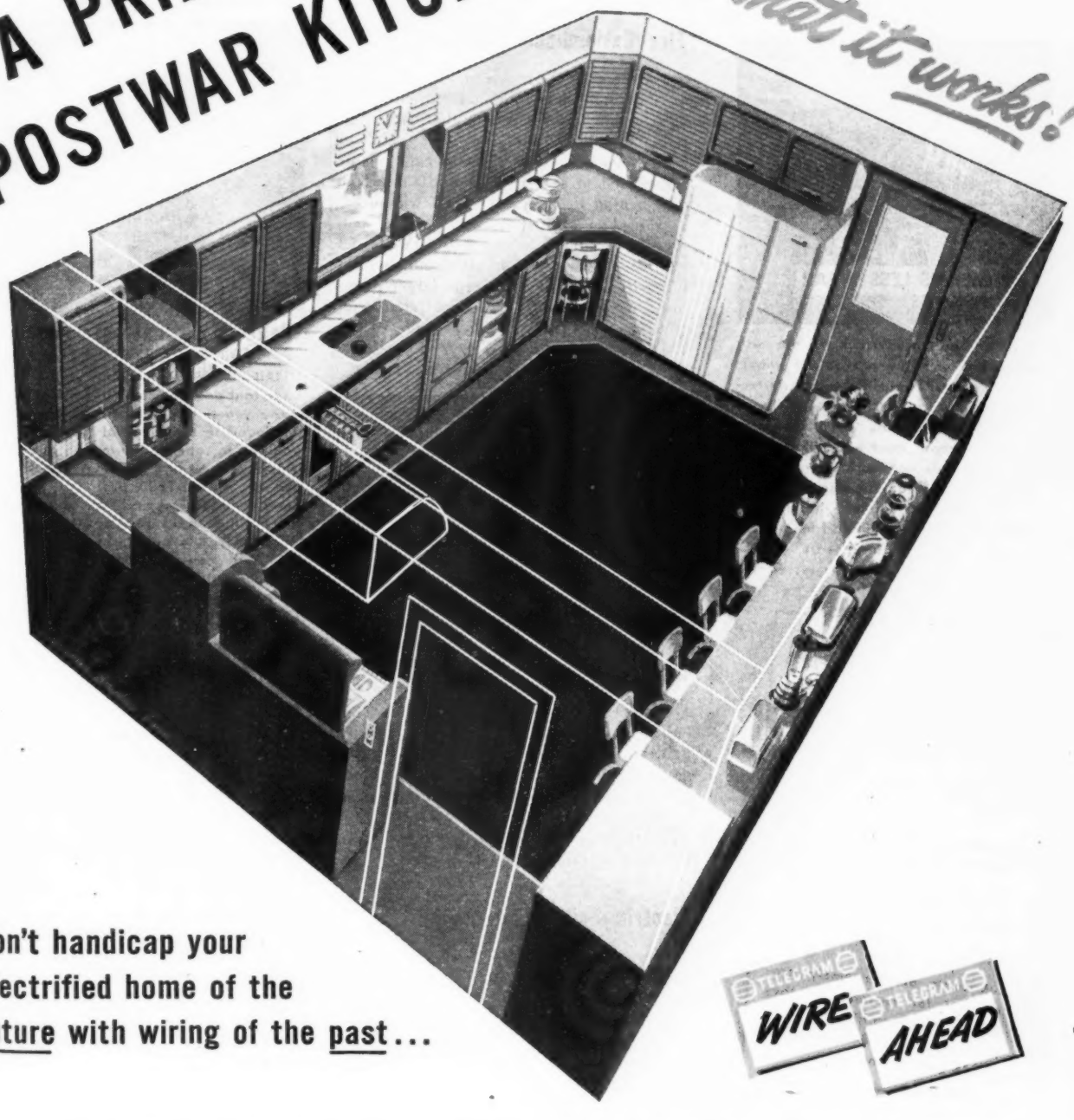
Cooling Towers

TYPE B SMALL, FORCED-DRAFT cooling tower is produced in five frame sizes suitable for water cooling of refrigeration condensers up to 20-ton capacity. Air-propulsion unit consists of a slow-speed double-inlet blower, which is said to result in exceptionally quiet operation.

Air inlet supply is obtained through the rear, with aluminum alloy propeller induced-draft fans, for No. 2-D towers (*shown above.*) Towers, in single fan assemblies, are in eleven frame sizes for capacities up to 150 gpm and in five twin-fan frame sizes for capacities up to 300 gpm. They are for general water-cooling applications, including air conditioning and refrigeration work. In larger sizes design is such that heat exchange coils may be located in spray zone

A PRIZE POSTWAR KITCHEN—

see that it works!



Don't handicap your electrified home of the future with wiring of the past...

TELEGRAM WIRE TELEGRAM AHEAD

Automatic housekeeping! It's a *must* for postwar homes. Refrigerator and electric range of course. Dishwasher—garbage disposer—washing machine—ironer. Exhaust fan—innumerable appliances.

They are all necessary. But don't ruin their operation by inadequate electrical wiring. To run your equipment *right*—you *must* have proper wiring.

What's the capacity of your electrical circuits? Will it make the grade with future additional equipment?

Too often postwar electrical wiring plans based on *past* experience lack *reserve* capacity to meet the huge future increase in electrical demands.

Manufacturers! This subject is as important in the factory as in the home. Industrial wiring plans too must anticipate future power loads out of all proportion to past formulas.

Obviously unplanned wiring, expensive alterations, will be more costly than planned wiring. Now—while you're in the blueprint stage—is the time to consult electrical contractor—utility power engineer. They too will advise: Wire Ahead! 44259

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York City 4... Sales Offices in Principal Cities

LUBRICATION IS INDUSTRY'S PRIME ESSENTIAL

The "all-out" production of the war period has not only proven the importance of proper lubrication but has effectively demonstrated the superiority of LUBRIPLATE Lubricants. Even the most confirmed skeptic must admit that when two surfaces do not touch, there can be no appreciable wear. The separating film of LUBRIPLATE is tougher. That is why LUBRIPLATE Lubricants impart longer life to shafts, bearings, and gears. LUBRIPLATE has qualities not possessed by conventional lubricants.

LUBRIPLATE

Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE

Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE

Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

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FISKE BROTHERS REFINING CO.
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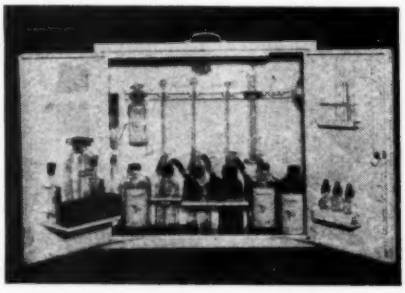
for indirect cooling of soft water for diesel engine jackets up to limited hp ratings, and for cooling of quenching oil and temperature control of various other fluids in industrial processing. *Cooling Equipment Div, Binks Mfg Co, 3114 Carroll Ave, Chicago, Ill.*

Fire Extinguisher Decals

SET OF THREE DECALCOMANIAS for first-aid fire extinguishers indicate briefly and clearly the fires for which that particular unit is suitable and those on which it should not be used. These decals can be transferred to extinguisher itself or to the wall behind its station. Decals will direct untrained or excited employe on the spot, preventing time loss and helping to avoid equipment misuse. Limited number of sets will be supplied free and larger quantities may be had for a nominal charge on request to company. *Walter Kidde & Co, 140 Cedar St, New York 6, N. Y.*



Water Tester

MULTITEST CABINET tests water samples for hardness, alkalinity, chloride, phosphate, pH, sulphite, sulphate and dissolved oxygen. Cabinet is equipped with glareless fluorescent lighting. Specially designed titration tables help to eliminate any possible splashing of sample. *Bird Archer Co, 400 Madison Ave, New York, N. Y.*

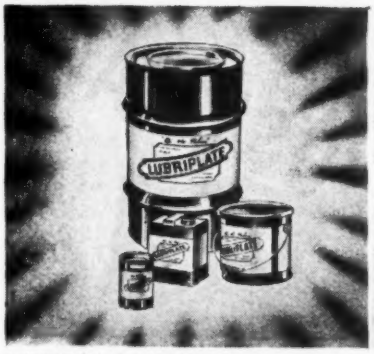
Electric Hoist

AE LO-HED ½-TON ELECTRIC hoist is said to be able to lift capacity loads more times per day and therefore handle more pounds per day than ordinary hoists. Hoist has a heavy-duty ¾-hp hoist-and-crane motor with high-starting torque and heavy-duty spur gearing. Lowering brake is of automatic, heavy-duty Weston screw-and-disk design. Bolt-and-suspension model weighs 195 lb and trolley model 225 lb. *American Engrg Co, Philadelphia 25, Pa.*

Electrical Ratio Meter

DESIGN OF METER MOVEMENT inverts conventional arrangement of such instruments by using a small, moving, permanent-magnet vane, the position of which is governed by the current ratio in two sets of stationary actuating coils, placed at an angle with one another. This arrangement provides a rugged construction and permits elimination of all hair springs. Movement may be adapted to any service in which it is desired to indicate the ratio between

LUBRIPLATE THE MODERN LUBRICANT



THERE IS A LUBRIPLATE PRODUCT FOR YOUR EVERY NEED

LUBRIPLATE represents one of the most important advancements in lubrication in many years. It possesses characteristics not found in conventional lubricants. In addition to superior lubricating qualities it prevents rust and corrosion. The adoption of LUBRIPLATE by practically all important industries and the Army and Navy is indeed a record of achievement. LUBRIPLATE is available in a number of fluid and non-fluid densities to meet every operating condition.

Rx FOR YOUR MACHINERY

No. 3—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers).

No. 107—One of the most popular grease type products for general application by pressure gun or cups.

No. 70—For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

Write for a booklet, "The LUBRIPLATE Film" written especially for your industry.

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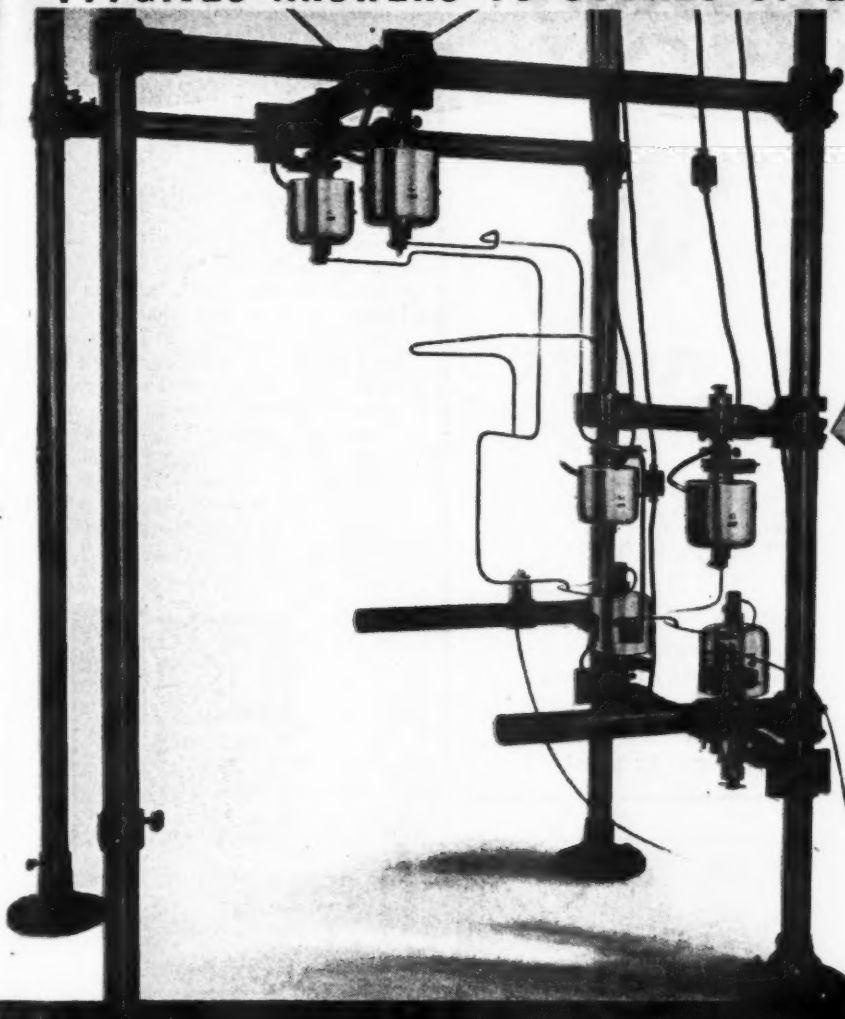
DETERMINING MOMENTS AND FORCES ELECTRICALLY ...GIVES ANSWERS TO SCORES OF EQUATIONS ACCURATELY



KELLOGG PIPING ENGINEERS CAN SUPPLY ACCURATE ANSWERS TO AS MANY AS 72 SIMULTANEOUS EQUATIONS—COVERING UP TO 12 POINTS OF FIXATION, WITH THIS APPARATUS!

The super-sensitive instruments which make this possible were designed and are used exclusively in the Kellogg Engineering Department for the sole benefit of Kellogg clients. By their use the most complicated design problems of high pressure, high temperature piping systems are solved accurately and quickly—an exact scientific analysis of the end reactions is arrived at.

There is no guess work, no possibility of error or delay in figuring, when these sensitive Kellogg instruments are used. They reduce figuring time, assure absolutely accurate results and thus save our clients time and money by giving them mechanically and scientifically correct piping systems for their individual needs as well as often substantially reducing the quantity of vital piping material

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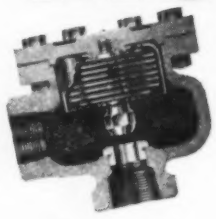
M***

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

For Efficient Operation and Long Life, Specify NICHOLSON



TRAPS

NICHOLSON STEAM TRAPS have the largest water and air discharging capacity of any trap in their price range. Cannot freeze, water-log or air-bind; intermittent discharge; same size valve orifice for all pressures. Sent on trial. Catalog No. 444 on request.

VALVES

NICHOLSON CONTROL VALVES are made in two, three, four-way, multi-port, metering, distributing and special types. For air, steam, oil, gas, tar or water. Also lever, foot, solenoid and motor operated types. Hydraulic pressures up to 5000 lbs. Catalog No. 543.

FLOATS

NICHOLSON WELDED FLOATS are made of stainless steel or chromium plated steel; spherical, cylindrical and elliptical shapes; sizes 2" to 14" diameter; with threaded female spud or tube through center. For pressures to 2000 lbs. Bulletin No. 339.

★

OTHER NICHOLSON PRODUCTS: Piston and Weight-Operated Steam Traps; Compressed Air and Gasoline Traps; Flexible and Compression Shaft Couplings; Expanding Mandrels; Arbor Presses; Steam Eliminators and Separators.

W. H. NICHOLSON & CO. 125 OREGON ST. WILKES-BARRE, PA.

On a rotary pump, the Viking name plate is your guarantee of service and dependability.

Those who have had Vikings in operation know what this really means, particularly in War-time, when it has been so difficult to obtain new equipment. Many Vikings are still standing up and doing a swell rotary pumping job, even though in normal times they would have been replaced long before now with new equipment.

This ability to "take it" and to "keep going" is proof of the sound design and rugged construction of Viking Rotary Pumps . . . features that insure dependable performance . . . features that mean the difference between a shut-down and keeping on the job. When writing about a pump in service, always mention the serial number shown on the name plate.

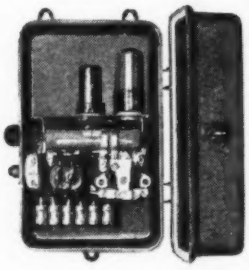
Look to the future. Write today for Bulletin 800 which describes Viking Rotary Pumps widely used in the power equipment field. Viking pumps are available on priority. Inquire as to delivery date.

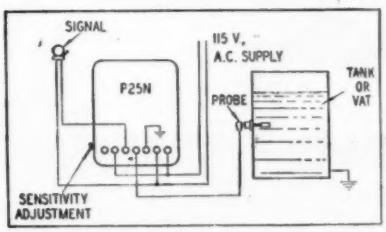
VIKING Pump COMPANY CEDAR FALLS, IOWA

two current values or voltages, independently of their magnitude. Where it is desirable to have the pointer swing off one end of the scale when de-energized, a small pull-off magnet is attached to the upper bridge. Coil resistances up to 1000 ohms are feasible and instrument operates dependably at currents down to 300 microamperes. Scale span ordinarily covers 120 circular deg. *Thomas A Edison, Inc, West Orange, N. J.*

Valve-Position Indicator

MODEL NO. 3 TEJAX valve-position indicating handwheel operates by a positive gravity bearing mechanism and is applicable to stems and shafts placed in a horizontal position. Readings in turns and fractions of turns are shown on white dials with black graduations, easily read from a distance. Indicator is adjustable in its own bracket to compensate for valve wear, which *Tejax* detects at once. *Tejax* indicator can be easily attached to valves in service by replacing regular valve handwheel. *Tejax Engrg Corp, 2 Allens Ave, Providence, R. I.*



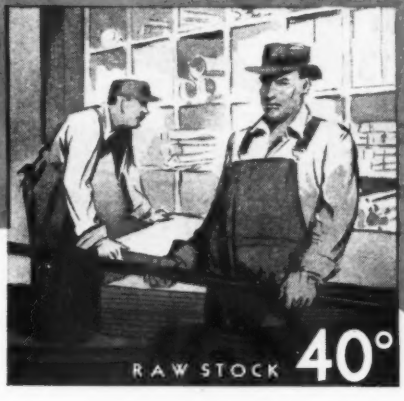


Electronic Concentrate Control

TYPE P25N DETECTS and controls, through operation of signals, valves or pumps, changes in liquid concentrations. This electronic method provides control for all applications in which changes in concentration are accompanied by a corresponding change in electrical conductivity.

Installation is made quickly and easily. Mount probe fitting on tank, with probe extending into liquid. Wire probe to electronic control, which may be located wherever desired. Set adjustment on the control housing so that control relay operates when liquid of a predetermined electrical resistance contacts the probe.

Type P25N has a sensitivity range of 100 to 5000 ohms and operates on a 5% change in probe-circuit resistance. Predetermined resistance value for which control is set remains fixed regardless of variations in line voltage or tube characteristics. Voltage applied to probe never exceeds 25 v, thereby eliminating electrical shock or explosion hazard. Control incorporates a single-pole double-throw relay,



FUEL SAVING ZONE CONTROLS

FOR INDUSTRIAL BUILDINGS

Available NOW!

YOU CAN COMMENCE NOW—not planning alone—but actual preparation to gain greater operating efficiency, increased operating economy . . . the two factors vital for successful factory management.

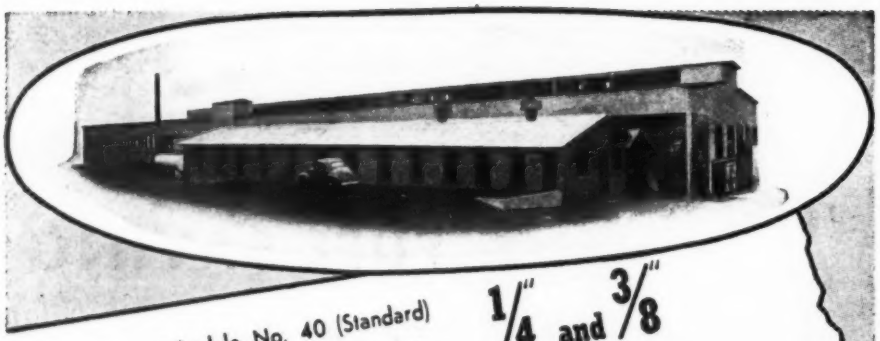
Minneapolis-Honeywell Fuel Saving Zone Control equipment is available for installation now. It provides a temperature control system tailor-made to suit the individual needs of your plant. Thus you can maintain in each "zone" of the building, the exact temperature required. Compensation is made for all varying elements usually encountered . . . outside weather, construction of the building, the time of occupancy and the kind of operation being conducted.

Lowered fuel cost however, is the important advantage. Heat saved in low temperature areas is used, *without waste,* to heat sections requiring higher temperatures. The cost of installation, surprisingly low, can actually pay for itself in fuel savings . . . You can arrange quickly for a fuel saving survey of your building, without cost or obligation. Call the Minneapolis-Honeywell office in your city, or write Minneapolis-Honeywell Regulator Company, 2702 Fourth Ave. S., Minneapolis 8, Minn. Branches in principal cities.

MINNEAPOLIS **Honeywell**

CONTROL SYSTEMS

Back The Attack—Buy MORE Than Before.



Schedule No. 40 (Standard) and No. 80 (Extra Heavy)

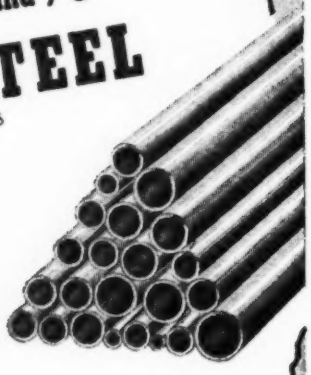
1/4 and 3/8

SEAMLESS STEEL

ASTM Specifications A53 & A106

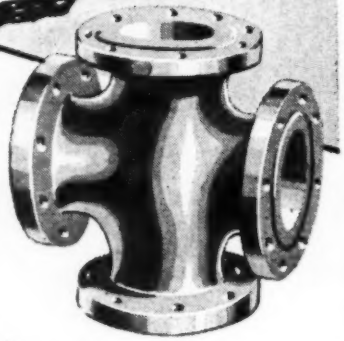
PIPE and NAVY TUBING

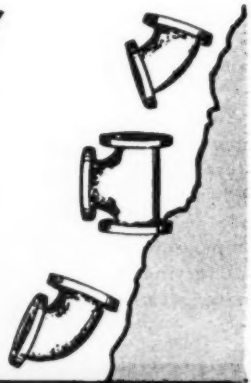
(44-T-13)



For all pressures and temperatures,

PTP CARBON and ALLOY CAST STEEL FLANGED FITTINGS





PIPE & TUBE PRODUCTS

INCORPORATED

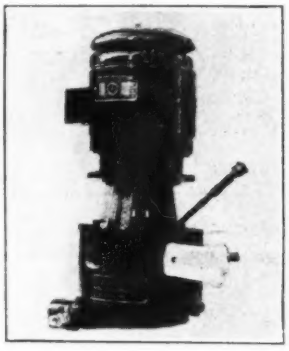
Manufacturers of Cold Drawn Seamless Steel Tubing

JERSEY CITY, N. J. • WORKS: READING, PA.

rated at 10 amp ac, 5 amp dc, for normally closed and open operation, and requires a 115-v ac 60-cycle supply. *Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.*

All-Purpose Conveyor

TOTE-ALL, a lightweight, portable endless-belt conveyor, is available in 13 ft. 9 in. and 20 ft sizes. Either may be driven by an electric motor or a gasoline engine. Conveyor comes with a gasoline engine of 1½ hp or, for heavy-duty work, 2.3 hp. If user has his own motor conveyor may be had without power unit. All models may be had with standard engine or high engine mounting for conveying bulky materials. Engine mounting on models equipped with gasoline engine is adjustable to keep engine level regardless of conveyor angle. Normal belt speed is 420 fpm. Variable speed-drive pulley is available. *Coaltoter Conveyor Co, 310 S Michigan Ave, Chicago 4, Ill.*



Condensate Return System

MIDGET NO-VENT boiler return eliminates steam traps, steam vents, orifice plates and steam reheating. System returns condensate directly back to boiler at practically the steam condensing temperature. Unit runs continuously to get maximum possible condensate return. Two 1-in. inlets collect up to 75-boiler hp in condensate. Noncondensibles are vented out of housing. Condensate is drawn into pump impeller at bottom and discharged through a 1-in. line to boiler. Entire *Midget* weighs less than 100 lb, so that it may be installed without concrete foundation, hung on piping or building, or supported from floor by a pipe nipple. *David Stout & Sons, 3943 Cleveland Ave, St. Louis, Mo.*

Cutters for Tool Holders

ARMSTRONG CARBIDE tool holders, for carbide-tipped cutters, now come with straight, right-hand off-set or left-hand off-set shanks, each in seven sizes. Armide cutters come tipped with carbides of two grades—*Armide* red for machining steel and *Armide* gray for machining cast iron, brass, bronze, aluminum and nonmetallics. All cutter sizes come ground to four standard cutter shapes and in standard or heavy-duty weights. These carbide-tipped tools are sold singly or in matched tool holder and cutter sets, boxed in fitted steel cases. *Armstrong Bros Tool Co, 301 N Francisco Ave, Chicago 12, Ill.*

Specially-Prepared Switch Copper by REVERE

Revere has developed a new method of manufacturing Switch Copper to meet the exacting requirements of the electrical industry on an economical basis.

The process produces Switch Copper with a surface finish far superior to regular commercial bar copper, and with exceedingly close tolerances. Flatness measured across the width of the bar is kept to the following Revere standards: — Convexity none. Concavity, .001″ maximum per side up to 2″ wide, .002″ per side, 2″ and over. Camber, or depth of lengthwise arc 1/8″ maximum in 8 feet. Edges are full rounded, square or as specified. Made from electrolytic copper, meeting the A.S.T.M. specifications for purity and conductivity.

This is really beautiful metal. Its superior finish and flatness mean that simple cutting and drilling are enough to produce switch blades that will make perfect contact, reducing current losses. Naturally, Revere Specially-Prepared Switch Copper carries a slight premium in price, but those who have used it report this is insignificant compared with the large savings made possible by abandoning the expensive finishing processes required when using ordinary commercial bar. Revere Switch Copper is also being used in: knife-blade fuses; switchboards; in other equipment requiring exposed bus bars. For further information, write Revere Executive Offices.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N. Y.

These NEW Catalogs, Booklets and Bulletins Are Yours for the Asking!

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATING

1 **SPRAY NOZZLES**—Eddington Metal Specialty Co, Eddington, Pa. 8-page bulletin No. 2046 discusses Edco spray nozzles for air conditioning and general industrial uses.

2 **DIRECT-FIRED HEATING**—Dravo Corp, 300 Penn Ave, Pittsburgh, Pa. 20-page bulletin No. 512, entitled "Portfolio of Outstanding Engineering in Industrial Heating," describes direct-fired warm-air method of heating and shows great war structures which are heated by this method.

3 **AIR FILTERS**—Air Devices, Inc, 17 E 42nd St, New York 17, N. Y. 16-page bulletin No. AF-44-1 contains data on new Agitair air filter line for air conditioning, ventilating, heavy-duty industrial and grease-removal applications. 2-page bulletins No. PF-44-1 and EX-44-1 describe Agitair Type P air filters and Agitair exhausters.

BOILERS AND AUXILIARIES

4 **WATER COLUMNS AND GAGES**—Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa. 20-page bulletin No. WG-1810 gives construction details, dimensions, prices and installations of Yarway water columns and gages. List of water-column and water-gage parts is included.

5 **VACUUM-CLEANING SYSTEM**—Spencer Turbine Co, Hartford 6, Conn. 4-page bulletin No. 137, Section 7A, describes Spencer stationary vacuum cleaning system for boilers.

6 **FUEL-OIL ATOMIZERS**—Engineer Co, 75 West St, New York 6, N. Y. 36-page bulletin No. OB-PC discusses Enco fuel-oil atomizers and ignition systems for pulverized-coal burners.

MECHANICAL TRANSMISSION

7 **SPEED REDUCER** — Elliott Co, Jeannette, Pa. 4-page folder on Bowes Drive, an electric device for speed reduction between modern high-speed prime movers and drive shafts, contains photographs of unit and its component parts, together with description of operation and other data.

8 **WIRE GROMMET V-BELTS**—Diamond Rubber Div, B F Goodrich Co, Akron, Ohio. 4-page folder explains and pictures construction of wire grommet V-belts.

9 **SPEED REDUCERS**—Philadelphia Gear Works, Inc, Erie Ave and G St, Philadelphia 34, Pa. 60-page bulletin No. 200 gives design features, load characteristics, service factors, horsepower ratings, capacities, weights, dimensions and installations of Philadelphia spiral-bevel speed reducers.

10 **V-BELTS**—B F Goodrich Co, Akron, Ohio, 74-page handbook discusses operating advantages, product qualities, service factors and general information covering V-belt field.

11 **SPEED CONTROL**—Reeves Pulley Co, Columbus, Ind. 4-page folder gives, in question-and-answer form, summary of what can be accomplished with Reeves speed control.

METERS AND INSTRUMENTS, MECHANICAL

12 **MEASURING INSTRUMENTS** — Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa. 28-page catalog describes all of Leeds & Northrup's measuring instruments, telemeters and controls for regulating power plant processes.

13 **MECHANICAL METER**—Cochrane Corp, 17th and Allegheny Ave, Philadelphia 32, Pa. 8-page publication No. 3010-31 discusses fundamental features of Cochrane high-torque flowmeter.

14 **INDIVIDUAL-MOUNT TACHOMETERS**—Jones Motrola Co, Stamford, Conn. 6-page bulletin No. 44-1 shows full-face and profile views rpm ranges, mounting dimensions and prices of individual-mount tachometers. Discussion of Jones multirange portable hand tachometer is included.

15 **THERMOCOUPLES AND ACCESSORIES**—Wheelco Instruments Co, Harrison and Peoria St, Chicago 7, Ill. 40-page bulletin No. S2-5 describes products and gives prices and recommendations for thermocouple users.

PRIME MOVERS AND ACCESSORIES

16 **AIR FILTERS**—Farr Co, 2615 Southwest Dr, Los Angeles 43, Calif. 4-page bulletin describes standard models of Far-Air filters. Bulletin contains graph charts and filter photographs.

17 **STEAM CONDENSERS** — C H Wheeler Mfg Co, Lehigh and Sedgley Ave, Philadelphia 32, Pa. 4-page bulletin No. 1144 gives a historical record of Wheeler's achievements in dual-bank steam condenser development.

18 **VACUUM PUMPS**—C H Wheeler Mfg Co, Lehigh and Sedgley Ave, Philadelphia 32, Pa. 4-page bulletin No. 944 pictures steam-jet air-ejector vacuum pumps with steam condensers.

WELDING

19 **RESISTANCE WELDING** — Progressive Welder Co, 3050 E Outer Dr, Detroit 12, Mich. 60-page bulletin No. WP-44, entitled "Resistance Welding at Work," contains examples of resistance-welding applications.

20 **CABLE CONNECTIONS** — Tweco Products Co, English at Ida, Wichita 7, Kansas. 12-page catalog describes complete line of Tweco cable connections for electric welding.

21 **WELDING ELECTRODES** — Page Steel & Wire Div, American Chain & Cable Co, Monessen, Pa. Booklet gives suggestions on how to select proper electrode for welding stainless steels. It includes helpful information on welding procedures.

(*Continued on page* 190)

HOW TO ORDER

Be sure to fill out, completely, one coupon for each piece of literature you order. (See sample below.) This gives your request authority and helps the manufacturer to address your copy completely. Readers who fail to prepare request blanks correctly may be disappointed under difficult postal conditions and limited quantities of bulletins available today.

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Your Title Power Engineer

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HOW TO MAKE STEAM COSTS "STAY LICKED"

Fuel-Saving Starts With CONTROL

IT'S ONE THING to win skirmishes in the endless war against high steam costs. It's quite another to find the winning tactics that rout fuel waste and high costs — that make them *stay licked.*

That's exactly how numerous executives—*shrewd strategists*—are winning on the boiler-room front: by utilizing Automatic Combustion Control. Hays Combustion Control *electrically* operated, measures every combustion factor, records every variation, instantly corrects those variations. It's simple, error-proof — AUTOMATIC.

With plant capacities straining to meet war materiel needs, with new equipment barred, with man-power restricted, many plants have found Hays Combustion Control ideal and practical. It saves man-hours, works tirelessly, 24 hours a day . . . gets the utmost efficiency—cuts operating costs.

Smart tactics: send now for the Hays Combustion Control Catalog full of useful steam-power data, "must" literature for industrial strategists.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

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"FOR MY POST,"

says the Colonel

"I'VE GOT TO HAVE

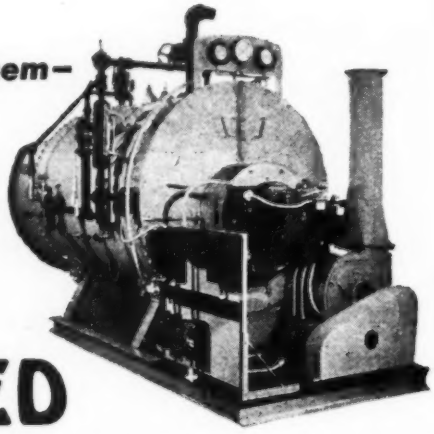
A dependable, *modern* steam plant . . .

It's got to be compact, self-contained, completely co-ordinated and 100% automatic . . .

Has to have 80% overall efficiency at least . . .

Must be oil-fired, with induced draft, without any smokestack."

Well—the Colonel got them—every one of those features. For he got a . . .



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The ultra-modern, complete power producing plant comprising, in one unit, oil burner, induced draft fan, boiler, controls, piping, wiring. Everything needed, all ready to hook up and start the burner. No stack required. Sizes 20 to 500 H. P. Now available for industry on priorities. Send coupon for full information.

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Name.....

Address.....
P-1-45

PREFERRED UTILITIES

PREFERRED UTILITIES for Results ENGINEERED

New Bulletins

(*Continued from page* 188)

OTHER EQUIPMENT

22 FLOAT CONTROL—Hancock Valve Div, Manning, Maxwell & Moore, Inc, Bridgeport 2, Conn. 20-page booklet No. 7156 discusses operation, installation and application of Hancock level control.

23 MATERIAL-LEVEL INDICATOR—Fuller Co, Catasauqua, Pa. 4-page bulletin No. I-2 describes Fuller material-level indicator and motion safety switch.

24 BANDING AND SPLICING — Punch-Lok Co, 321 N Justine St, Chicago 7, Ill. 6-page bulletin No. 108 outlines electrical applications of Punch-Lok method of making flexible-cable line taps and solid-wire line taps, clamping guy wire guards and anchors, splicing electric welding cable, etc.

25 ACETYLENE GENERATORS—Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 4-page bulletin contains line of Airco acetylene generators. Sizes, capacities and weights are included.

26 INSULATING CEMENT — Dept TP-1, Universal Zonolite Insulation Co, S LaSalle St, Chicago 3, Ill. 8-page booklet gives characteristics, uses, applications, test results, etc, of Zonolite high-temperature insulating cement.

27 PIPE INSULATION — Universal Zonolite Insulation Co, 135 S LaSalle St, Chicago 3, Ill. 4-page booklet discusses basic features of Zonolite b-t-u insulation for underground piping.

28 MICROMETERS AND DIAL INDICATORS—B C Ames Co, Waltham, Mass. 56-page catalog covers dial indicators, micrometers, comparators, cylinder gages and thickness measures.

29 CARBIDE-TIPPED TOOLS—Metro Tool & Gage Co, 4240 W Peterson Ave, Chicago 30, Ill. 6-page bulletin describes complete line of Metro standard carbide-tipped tools for turning, facing and boring operations on steel, cast iron, bronze, aluminum, nonmetallics, etc.

30 MATERIALS-HANDLING SYSTEM —Factory Service Co, 4615 N 21st St, Milwaukee 9, Wis. 20-page book discusses Turner system of materials handling. Interchangeable and interlocking units are described.

31 PERFORATED METALS—Diamond Mfg Co, Wyoming, Pa. 28-page catalog No. 34 gives uses, advantages, perforation arrangements and ordering instructions for perforated metals and metal products.

32 METAL HOSE—Chicago Metal Hose Corp, Maywood, Ill. 12-page pamphlet, entitled "Flexible Metal Hose for Every Industrial Use," shows basic types of flexible metal hose available and some of their specifications.

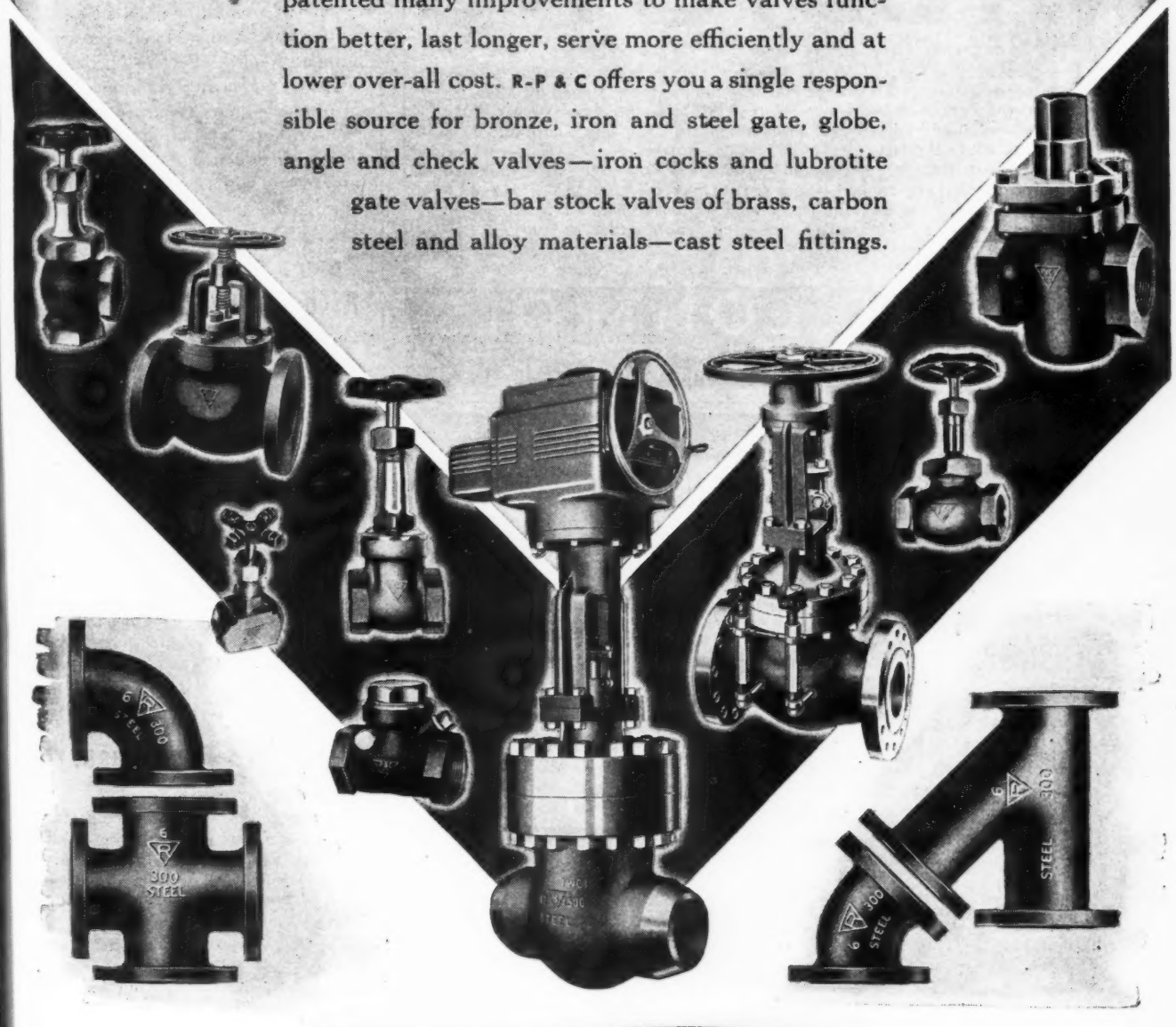
33 CLAMPS AND FITTINGS—Punch-Lok Co, 321 N Justine St, Chicago 7, Ill. 8-page catalog No. P-1 on clamps and fittings contains complete technical data on entire line to aid in application and proper use of Loking tool for connecting male and female fittings, nipples, menders, or pipe to hose.

34 FEED TANKS—Marine Dept, Elliott Co, Jeannette, Pa. 30-page instruction manual No. NH-500 gives purpose, construction and operation of deaerating feed tanks.

35 LOCKNUT—Standard Pressed Steel Co, Jenkintown, Pa. 4-page bulletin describes Flexloc locknut, which is being introduced to general industrial market. Formerly, it was available for Army ordnance and aircraft purposes only.

Remember THIS WHEN YOU NEED Good Valves

READING-PRATT & CADY has been making good valves for many years—has, in fact, originated and patented many improvements to make valves function better, last longer, serve more efficiently and at lower over-all cost. **R-P & C** offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—iron cocks and lubrotite gate valves—bar stock valves of brass, carbon steel and alloy materials—cast steel fittings.



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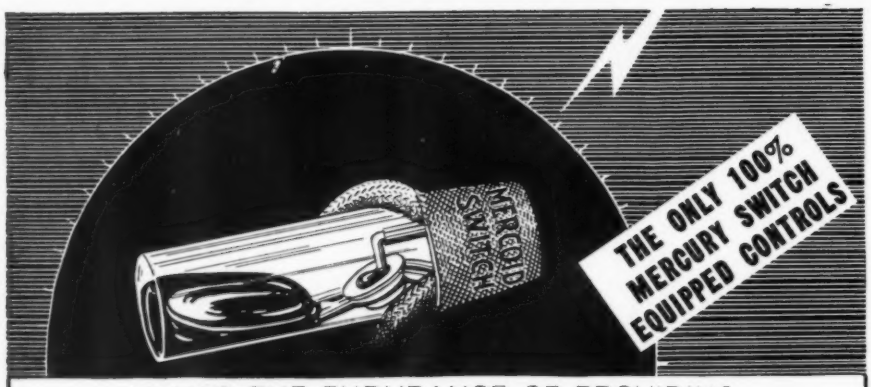

IT HAS THE ENDURANCE OF PROVIDING

MILLIONS

OF "MAKES" AND "BREAKS" IN THE ELECTRICAL CIRCUIT

The mission of a Mercoid Mercury Switch in an automatic control is to assure longer life and greater dependability—minimizing the need for attention after the control is in service. Mercoid Controls lend themselves to quick installation and adjustment, all of which are invaluable contributions in a time of national crisis.

Mercoid Switches, the distinguishing feature, used exclusively in all Mercoid Controls, are especially designed types of hermetically sealed mercury switches. They are not affected by dust, dirt, moisture or corrosive gases, nor are they subject to open arcing, oxidation, pitting or sticking of contacts—common causes of trouble.

Keep these important facts in mind when selecting automatic controls.

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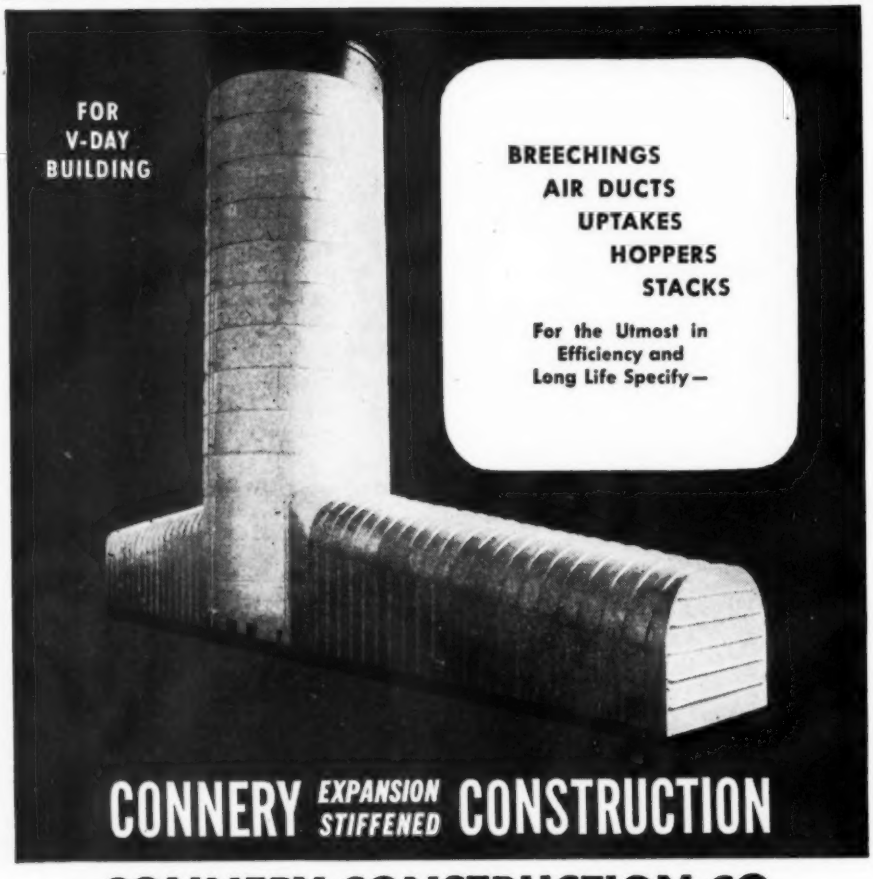


CONNERY EXPANSION STIFFENED CONSTRUCTION

CONNERY CONSTRUCTION CO.

SECOND & LUZERNE STS. PHILADELPHIA

Power News

(*Continued from page* 134)

Supplies of coal, gas and burner oil will become increasingly critical until the enemy in all theaters of war is vanquished, Secretary Ickes warned when announcing the appointment of 39 additional coordinators who will serve without pay to help promote the National Fuel Efficiency Program (POWER, Dec, 1944, p 146), sponsored by the Government in cooperation with industry.

The new coordinators join other volunteers in helping combat waste and promote more effective utilization of fuels. Fuel savings ranging 5 to 20% are realized by larger consumers of fuels where a thoroughly organized course of action and follow-up are employed by factories, schools, hospitals, office buildings and other plants.

Fewer Men, More Work in Bituminous-Coal Mines

Bituminous-coal mines in the U. S. employed fewer men but did more work and produced more coal in 1943 than in 1942, according to Bureau of Mines' reports covering 1943 operations at mines that produced 81% of 1942 output. Statement is based upon assumption that the same companies continued to represent same proportion of total coal-mining business in 1943 as in 1942. The industry, it is estimated, employed 415,000 men in 1943 and performed labor equal to 111 million man-hour days, or slightly more than 809 million man-hours. Operating time for the average worker was 269 days. Average length of workshift was 7.27 hours per man.

New Laboratory for Synthetic Fuel Research

Following a conference on the Bureau's long-range study of producing gasoline and other essential fuels from coal and oil shale, Secretary Ickes announced plans for construction of a liquid-fuel research and development laboratory by the Bureau of Mines at Bruceton, Pa.

The large laboratory buildings will be ready by the fall of 1945. Various laboratory units and other facilities will occupy about seven acres and will include three large buildings, a powerhouse and several smaller service buildings.

Secretary Ickes emphasized that the laboratory, to be called the Research and Development Laboratory for Synthetic Liquid Fuels, should not be confused with demonstration pilot plants that the Bureau will build to demonstrate two methods for producing gasoline and other coal products.

The laboratory, which will work out the *kinks* in the various processes, will serve two purposes: (1) to reduce cost of con-

2¾% Nickel Steel locomotive rods, one bent cold to show ductility.

QUENCHED AND TEMPERED

NICKEL STEEL

FORGINGS COMBINE

EXCEPTIONAL DUCTILITY WITH HIGH TENSILE STRENGTH

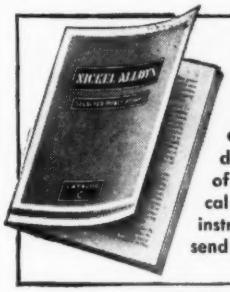
Composition and Typical Properties of Normalized Quenched and Tempered 2¾% Nickel Steel Rods

Description or Size	Melt Yield Pt. No. #s per Sq. In.	Tensile Strength #s per Sq. In.	Elong. % in 2 In.	Reduction in Area %	ANALYSIS					
					Car.	Mang.	Phos.	Sul.	Sil.	Ni
Main Rod....	92900	110000	25.0	64.4	.31	.78	.027	.026	.25	2.75
Main Rod....	86500	104500	25.5	65.6	.32	.86	.034	.032	.29	2.69
Main Rod....	86360	104400	26.0	64.8	.32	.86	.034	.032	.29	2.69
Main Rod....	87850	102350	26.0	66.2	.31	.89	.037	.025	.32	2.69
Front Rod....	86000	102250	25.0	67.3	.29	.82	.035	.027	.24	2.71
Front Rod....	83900	104250	25.0	66.1	.29	.82	.035	.027	.24	2.71
Front Rod....	86850	104250	27.0	66.1	.32	.86	.035	.025	.30	2.65
Front Rod....	89500	107050	25.5	65.6	.32	.86	.035	.025	.30	2.65
Back Rod....	89500	107650	25.0	62.7	.30	.79	.030	.025	.22	2.71
Back Rod....	87500	106450	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	87000	105600	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	88150	104850	26.0	66.8	.29	.82	.035	.027	.24	2.71

Specimens Taken from Mid-Section of Prolongations of the Forgings

The above table compiled by the American Locomotive Company shows the chemical compositions and mechanical properties of some normalized, quenched and tempered nickel steel front, main and back rods recently produced as replacement rods for locomotives being speeded up and rebalanced. These values are typical of replacement rod forgings recently tested by that company.

Quenched and tempered nickel steel forgings provide high tensile strength and ductility, combined with unusual toughness and high fatigue strength—qualities which tend to obviate breakage and assure long, trouble-free service when employed in heavy duty machinery and equipment.



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* Nickel *

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall Street, New York 5, N. Y.*

A GOOD THING TO FIND OUT

IF your local distributor carries MAGNOLIA ANTI-FRICTION METAL in stock, you know where you can get it . . . in a hurry . . . when you are faced with an emergency.

MAGNOLIA ANTI-FRICTION METAL is the best known, most widely used of all babbitt metals. And, supply houses can order it for stock, to sell to their customers, *without a priority*.

Why not ask your distributor today if he is carrying MAGNOLIA ANTI-FRICTION METAL in stock?

MAGNOLIA METAL CO.
ELIZABETH 4, N. J.

MAGNOLIA BEARING METALS

structing larger-size demonstration plants and (2) to improve methods of producing liquid fuels from coal so that demonstration plants will be the most modern that can be built and operated. Extensive laboratory facilities at Bruceton will develop improved techniques over those now employed in England and Germany.

Dr H H Storch, recently named chief, research and development div. will head the Bruceton Research and Development Laboratory for Synthetic Liquid Fuels. Dr Storch said that the laboratory will employ about 280 persons and that about half will be technical persons. Nucleus of the Bruceton staff now is undergoing training at Pittsburgh, where the Bureau has been working on various phases of the research program since 1936.

Jet Propulsion Units for Planes

As a result of introducing auxiliary jet propulsion units, known to the Navy as JATO, PBM's are reportedly airborne after a 30 to 60% shorter take-off run than was needed by the same boats without auxiliary units.

JATO jets are of the rocket type containing their own fuel and oxygen, as opposed to the thermal jet power plant of Bell Aircomet and other all-jet planes. Mariner installation consists of four units—two under each wing. When the big flying boat starts on its take-off run, these rockets are detonated electrically to supply about 1300 additional horsepower at the time when it is most needed. Each rocket supplies a thrust which pushes the PBM upward, as well as forward, thereby enabling it to get off the water after an amazingly short run.

Addition of auxiliary units makes it possible to fly big patrol bombers at far greater gross weights than the 52,000 lb for which they are designed, which means more fuel, more range and added bomb loads. It also enables big flying boats to take off from even heavier seas than the 12- to 15-ft waves they have surmounted in numerous deep-sea rescues.

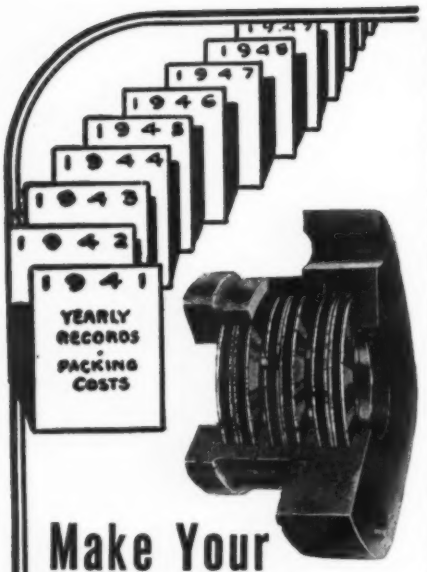
U. S. Naval Academy Air Station at Annapolis did the major part of the experimental work for developing the jet assist for the PBM.

Job-Application Help For Service Men

Orville E Reed, 132 S Isbell St, Howell, Mich., professional writer of letters and of direct-mail advertising, announces that he will help any returning service man by writing for him a letter of application, without any direct or indirect charge or cost. Service man is asked to write Mr Reed for a copy of a Qualifications Inventory Blank to be filled in, giving facts about himself and his experience, to be used in preparing the letter.

OWU approves installation of a 25,000-kw steam turbine in Beloit plant of Wisconsin Power and Light Co. Unit will operate in 1946.

Orders since Spring
...still Snowed Under!
War demands for Toledo Pipe Tools have "snowed us under"—but we're doing our best to fill these orders with all possible speed. All of your orders to the distributor are being filled in accordance with priority regulations. However, the continued shortage of manpower and materials still means delay to many of our customers. We're sorry—but we know you'll understand it's part of the price of Victory. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.
TOLEDO
PRECISION PIPE TOOLS



Make Your Next Packing Job *L-A-S-T!*

During these days of increased production, it is especially annoying and costly to experience shutdowns due to packing trouble.

There is a solution. Install France "Full-floating" Metal Packing in your engines, pumps and compressors. The result is increased efficiency. And each job lasts for years without maintenance expense. Saves money, too, in the long run.

Installation is a simple procedure. See that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C. Write for details and Folder M-7. Make your next packing job L-A-S-T!

Original FRANCE Sold on approval Satisfaction Guaranteed

THE FRANCE PACKING COMPANY
Tacony Philadelphia 35 Penna.

Mid-Continent Representative:
Mr. J. M. FULLER, 3725 West 7th St.
FORT WORTH, TEXAS

Original FRANCE METAL PACKING

ASTM Schedule Of 1945 Meetings

Following list includes national meetings and a number of local meetings of American Society for Testing Materials:

1. New York District: *Petroleum and Some of Its Modern Derivatives*, Engineering Societies Bldg, Jan 17
2. Philadelphia District: Symposium on Magnetic Particle Testing, Hotel Benjamin Franklin, Jan 22
3. ASTM Committee Week, Hotel William Penn, Pittsburgh, Feb 26 to March 2
4. 1945 Spring Meeting, Hotel William Penn, Pittsburgh, Feb 28
5. Philadelphia District: Symposium on Experimental Stress Analysis, Franklin Institute, April 12
6. Annual Meeting, Hotel Statler, Buffalo, June 18 to 22

IN CANADA

First unit of the 140,000 hp hydroelectric development at Brilliant, B. C., is delivering power to the C M & S smelter and plants at Tadanac and Warfield, West Kootenay Power & Light Co, Ltd, announces. A second unit is about 90% complete and is expected to go on the line transmitting power shortly. First unit is capable of an average of 35,000 hp.

When power requirements demand installation of the additional two units, for which provision has been made at Brilliant, and hydraulic work is completed, total developed horsepower on Kootenay River will be over 400,000. This is the fifth power development on Kootenay River within a distance of 15 mi as the stream flows. Plants are at Corra, Linn, Bonnington, South Slocan and Brilliant.

Dominion Water and Power Bureau, Federal Dept Mines and Natural Resources, starts work this year on intensive field surveys of the whole potential water power and other natural resources of the Columbia River basin in Canada.

It will take years for the International Joint Commission to reach final decisions on the Columbia Basin. C E Webb, chief engineer of the bureau in B. C., in a 3-week's tour studied development possibilities on both sides of the line from the river's headwaters in B. C. to its mouth at the Oregon coast.

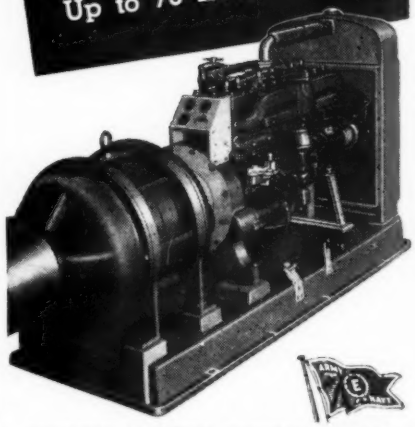
Several power developments on the Columbia in B. C. include those of West Kootenay Power & Light Co, subsidiary of Consolidated. There are many big power developments on the American side and others in prospect.

Continuation of the Joint Commission's studies will not hold up new developments. They will be dictated by immediate and sectional needs, but authorization will be based on the commission's studies looking to a complete future scheme.

A new boiler and turbine-driven generator has been completed at Kamloops, B. C., steam plant of the B. C. Electric Railway Co, which will practically double plant capacity. Equipment was ordered over three years ago but installation was delayed by wartime conditions.

How Much Would a POWER FAILURE Cost You?

If your source of electricity failed, would a stand-by unit take over — or would you just suffer your losses? A U. S. Emergency Electric Plant is your best insurance. Write for Emergency line catalog on models now available. Up to 75 KW.



UNITED STATES MOTORS CORP.
552 Nebraska St. Oshkosh, Wis.

The U.S. line includes Gasoline and Diesel Units up to 75 kw.

U.S. ELECTRIC PLANTS FOR STAND-BY SERVICE

FOSTER REGULATION ENGINEERING

Saves Maintenance Time

for example:

1 Major overhaul, when necessary, without breaking the line

3 Guide and spring easily replaced

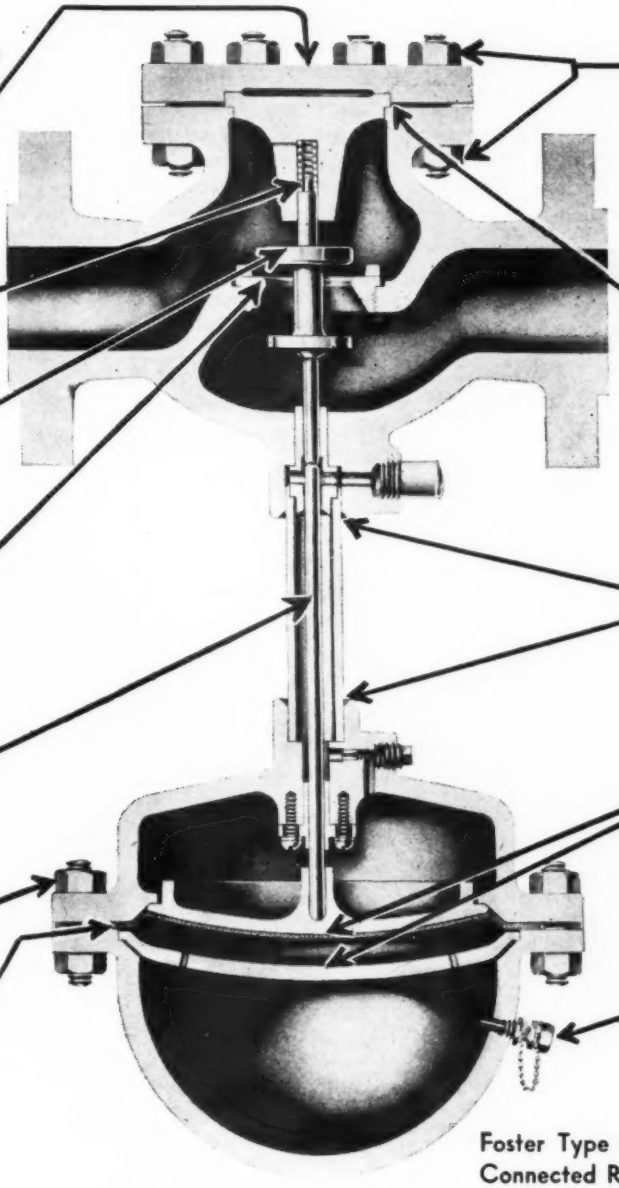
5 Main valve accessible — easily reseated

6 Main valve seat ring replaceable

7 Pushrod removed from lower end

2 All bolts are *stud* bolts — easily loosened

10 Diaphragm unit can be removed without disturbing rest of valve



2 All bolts are *stud* bolts — easily loosened

4 Ground joint — no gasket required

8 Brazed — no packing required

9 All smooth contact surfaces for diaphragm

11 Air fitting replaceable

Foster Type Q-1 Air Dome Loaded — Direct Connected Reducing Valve for Steam Service

Foster Regulation Engineering, built into each valve, is your assurance of years of accurate trouble free operation.

★ BUY MORE BONDS ★

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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STORE MORE COAL *NOW*
The Need is Urgent!

Pictured above is a Sauerman Scraper System operating a 10 cu. yd. Crescent Scraper on a storage area semi-circular in shape and 400 ft. in radius. This machine handles an average of 400-tons an hour, either storing or reclaiming. From a cab overlooking the storage area, the operator has push-button control of every move of the scraper system.

Write for Catalog

HEADS of government and industry agree that increased storage of coal is needed now to safeguard manufacturing schedules in the months to come.

In answer to the need, Sauerman Power Scrapers are being installed at numerous plants throughout the nation, in some cases to provide coal storage where none existed before; in others, to expand existing storage facilities at low cost. The sizes of the projects range from a few thousand tons a month to over a million tons a year.

Sauerman Equipment stores and reclaims safely, rapidly, cleanly for only a few cents per ton. Builds a homogeneous pile in compact layers—free of combustion hazards. Operates with a minimum of champing across pile and avoids dirt and dust of heavier equipment.

SAUERMAN BROS., Inc.

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The SHELLFIN* Heat Exchanger... a DOWNINGTOWN Specialty

* Pat. Applied for.

An exclusive Downingtown development, the Shellfin is a shell and finned tube heat exchanger usually built in small sizes.
The Shellfin represents the first development in high efficiency finned tube units suitable for liquids of medium to low viscosity.

Availability — Semi-finished parts and some tubes are stocked. Thus assembly of Shellfin units can be made very promptly, in fact more quickly than other type units.

Materials—Tubes, tube sheets, shells and heads are available in a variety of materials including stainless steel.

Applications—In its basic form the Shellfin unit is well suited to a number of uses; cooling clean oils and solvents, condensing organic vapors, partial condensation of vapors, cooling compressed gases, vaporizing organic solvents and for other uses.

Engineering consultation — Downingtown engineers will recommend the right size unit and the proper materials to suit your needs. Bring us your problems.

The new Downingtown Heat Exchanger bulletin describes the SHELLFIN in detail — also contains valuable information about other Downingtown exchangers.

DOWNINGTOWN IRON WORKS
DOWNINGTOWN, PA.
HEAT EXCHANGERS

APPOINTMENTS

Wickwire Spencer Metallurgical Corp announces appointment of **Jack W Forbes** as sales manager . . . General sales offices of springs and formed wire div and automotive div of **Wickwire Spencer Steel Co** are relocated at New Bond St, Worcester, Mass. District sales office continues to be at 500 Fifth Ave, New York City. **Harold F Ray** has become associated with Wickwire Spencer in an executive accounting capacity at New York office.

Wheelco Instruments Co has named **John G Davison** as Colorado representative and **Olin Phillips** as representative in northern Ohio territory. State of Minnesota has been added to territory served by **L E Cyrtmus** . . . **Bailey Meter Co** announces appointment of **P S Dickey** as chief engineer. He will supervise all engineering, research and design activities and will be assisted by **H H Gorrie,** assistant chief engineer, and **R E Clark,** contract engineering manager . . . Sales, advertising and service dept offices of **Stewart-Warner Corp** are located again at main plant, 1826 Diversey Parkway. Alemite, instrument and radio dept were included in move.

Yarnall-Waring Co appoints **S R Edwards** in charge of new southwestern sales office at 805 Texas Bank Bldg, Dallas, Texas . . . **Briggs Clarifier Co** has made **M N Dannenbaum Co,** 2409 Wayside Dr, Houston 12, Texas, distributor in East Texas and Gulf Coast territory and **McGregor & Werner, Inc,** 1411 20th St N W, Washington, D. C., distributor in Maryland, Delaware and District of Columbia territory . . . **John Thomas Gillespie** has been named manager of export sales for **Watson-Stillman Co.**

Edward G Seubert retires from presidency of **Standard Oil Co of Indiana** after serving company more than 52 years and heading it as chief executive more than 15 years. He remains a director and becomes chairman of executive committee of board. **Robert E Wilson** returns to Chicago and becomes chairman of board and chief executive officer of Indiana company. He takes over Mr. Seubert's responsibilities as chairman of board of **Pan American Petroleum & Transport Co. A W Peaks** advances to office of president. His place is filled by **F O Prior** as director and vice-president of Indiana company. He will also be chairman of board of **Stanolind Oil & Gas Co, Stanolind Pipe Line Co** and **Stanolind Oil Purchasing Co.**

University of Pittsburgh names **Dr Alexander J Allen** as Westinghouse graduate professor of engineering. Dr Allen will work with Westinghouse educational dept in planning a series of courses leading to advanced degrees for company employes. In addition, he will devote a part of his time to original research work.

Bridgeport Brass Co promotes **Austin R Zender** to vice-president in charge of sales. Mr. Zender joined the company in 1936, when he became sales manager of condenser and tube div at company's New York office. In 1941 he was transferred to

Typical comments by Diesel operators who use Gulf Parvis Oil:

"PROVIDES BETTER LUBRICATION"

"HELPS US GET TOP PERFORMANCE"

"KEEPS OUR MAINTENANCE COSTS DOWN"

"Good lubrication with Gulf Parvis Oil M helps us get maximum kw.-hrs. and low maintenance costs from this unit," says this Chief Engineer of a modern water and light plant, shown consulting with a Gulf Service Engineer.

GULF PARVIS OIL is writing a list of definite benefits in the operating records of hundreds of Diesels. This "dividend" list includes less wear, fewer shutdowns for repairs, lower maintenance costs, and better all-round performance.

Gulf Parvis Oil has superior lubricating value and long life—two important assets that insure a better protection job under today's peak load operating conditions.

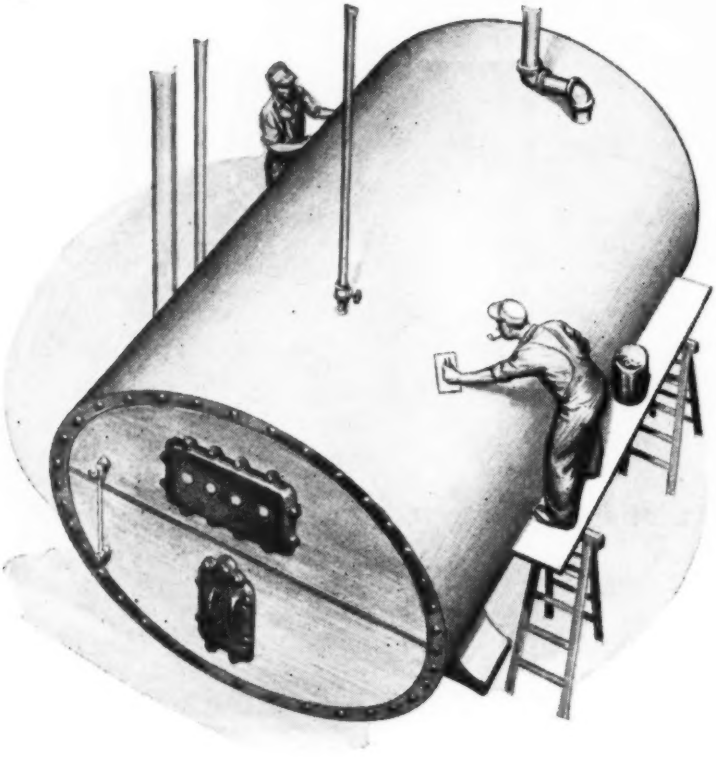
If you are not one of the hundreds of enthusiastic users of Gulf Parvis Oil, it will pay you to investigate—call in a Gulf Lubrication Service Engineer and ask him to recommend the proper grade to fit your particular requirements.

Gulf Parvis Oil—and the more than 400 other quality lubricants in the Gulf line—are available to you through 1200 warehouses located in 30 states from Maine to New Mexico. Write, wire, or phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION · GULF REFINING COMPANY · GULF BUILDING, PITTSBURGH 30, PA.

★ The makings of a BEAUTIFUL FRIENDSHIP



★ This bond with metal survives a lot of punishment . . .

Even *rust* can't come between metal and B-H No. 1 Cement! A special rust-inhibitor prevents corrosion and assures a permanent bond—whether the cement is applied on a hot surface and dried instantly or slowly air-dried over a period of time.

No. 1 Cement is made—by an exclusive process—of high-temperature-resisting, nodulated B-H *black* rockwool and other ingredients. Because it does not form a homogeneous mass, the *black* rockwool retains its physical characteristics; the countless *dead-air cells* provide full insulating efficiency up to 1800° F.

The cement retains sufficient elasticity to absorb normal expansion and contraction, without peeling or cracking. Easily applied without skilled labor; 100% reclaimable up to 1200°.

Please write for a practical sample and complete data.

For *one-block* insulation—at all temperatures up to 1700° F.—write for illustrated data on MONO-BLOCK.

Address: **Baldwin-Hill Co., 575 Klagg Ave., Trenton 2, N. J. Plants in Trenton, N. J.; Kalamazoo, Mich.; Huntington, Ind.**

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

home office and named sales manager of tube and pipe div. Soon after Pearl Harbor, Mr Zender took charge of all matters dealing with priorities and on Dec. 27, 1942, he was appointed director of sales.

Aluminum Co of America has named **Frank Jardine** manager of development div, Cleveland branch. **John R Willard** has been placed in charge of sales development div at New Kensington, Pa., and **B J Fletcher** as chief engineer. All three report to **R V Davies,** assistant general sales manager . . . **J W Mullally** has resigned as chief of wire and cable branch of copper div of WPB and has resumed his work as manager of bare and weatherproof sales of **Anaconda Wire & Cable Co,** with headquarters in New York. **J L Tindale** was appointed special representative on rural line extensions.

Mechanite Research Institute of America elected following officers for 1944: **Oliver Smalley,** president; **H B Hanley,** first vice-president; **A C Denison,** second vice-president; **C S Nichols,** secretary-treasurer . . . **Lincoln Electric Co** appoints **Paul James** as Syracuse district manager. **E L Smith** has been made district manager of Rochester office. Company has also transferred **George S Stevens** to Charlotte, N. C., as field representative and engineer . . . **Sperry Products, Inc,** adds **J L Stuart** to technical staff. Mr. Stuart will handle, as technical editor, all technical writing on hydraulic remote control line and other Sperry products.

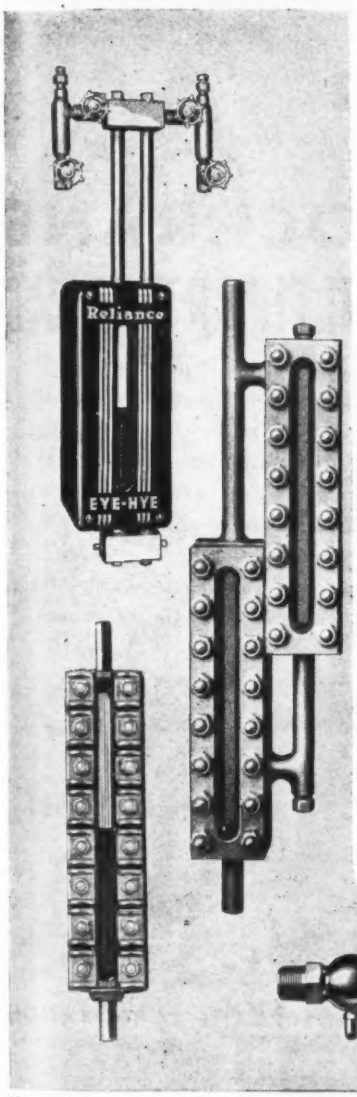
Dr Paul W Leppla has been placed in charge of **Cardox Corp's** electrochemical activities. **Dr John L Gring** succeeds Dr Leppla as chief chemist of research div . . . **B F Goodrich Co** announces appointment of **W A Smith** as manager of suspension sales of industrial products div. **James M Robbins** has been named technical representative of B F Goodrich Co on staff of new Colombian Tire Co in Bogota, S. A. . . . **United States Rubber Co** has made **Herman A Everlien** general sales manager and **Walter F Spoerl** merchandise manager of mechanical goods div. **James E Power** is eastern sales manager of div.

Board of directors of **Goetze Gasket & Packing Co** elected **Kenneth McCreary** president . . . **Allis-Chalmers Mfg Co** appoints **R W Davis** general manager of Norwood, Ohio, works . . . **Globe Steel Tubes Co** has named **Frederick K Krell** advertising manager, with headquarters at general sales office in Milwaukee . . . **Reliance Electric & Engrg Co** has elected **Clarence L Collens** to newly created post of chairman of board. **James W Corey** becomes president of company. **A M MacCutcheon** was elected to fill office of senior vice-president. **Roscoe H Smith** was placed in office of secretary, but will continue his duties as head of sales promotion dept.

A M Buxton has been promoted to assistant sales manager of **Cooper-Bessemer Corp.** In addition to sharing responsibilities of general sales manager, Mr Buxton will direct company's oil and gas field

Small equipment that keeps your *big* equipment safe . . .

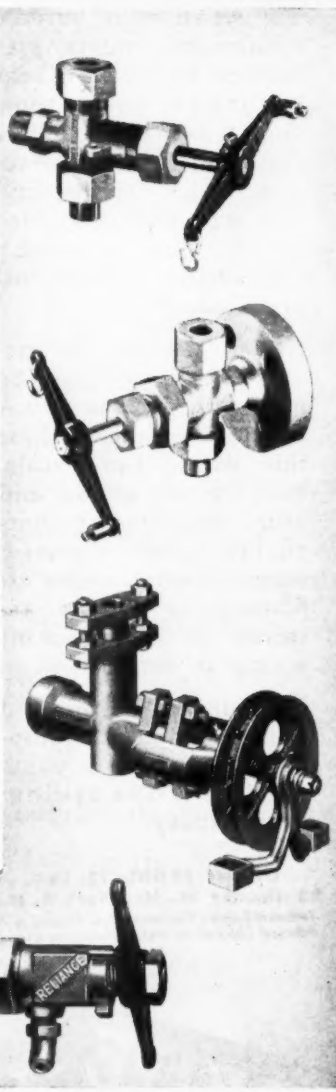
the dependable Reliance Boiler Safety Accessories



Don't overlook the *small* equipment that keeps the *big* equipment running smoothly. Reliance Safety Devices are mainly applied to boiler water level supervision, but the well-being of your boilers affects other "big" equipment, as you know. So the selection of high-grade accessories is of major importance. Water level safety means avoidance of expensive accidents that can cripple your production and injure sorely-needed personnel. • For keeping your power plant in the best of trim now, or for your future planning of new or revised power facilities, keep posted on the latest in Boiler Water Columns and Accessories Equipment. • Reliance has specialized for 60 years—offers you the most complete service in approved devices for water level supervision. • Write for the bulletins that interest you. . . .

382 Reliance EYE-HYE Remote Reading Liquid Level Indicator • 434 Reliance PRISMATIC Water Gage Inserts • 437 Reliance Mica-Protected Flat Glass Inserts 418 Reliance Water Gage Valves • 438 Reliance Water Column Gage Cocks • 414 Reliance Boiler Alarms for pressures to 250 lbs. • 415 Reliance Boiler Alarms and Water Columns without alarms for pressures above 250 lbs.

THE RELIANCE GAUGE COLUMN CO.
5902 Carnegie Avenue, Cleveland 3, Ohio



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Reliance

YOUR ANSWER for speeding wartime MAINTENANCE

Heat Exchangers Cleaned Easier

To clean your surface condensers, coolers, preheaters and other heat exchange units thoroughly as well as at low cost, try the more effective, easier Oakite way. You will find it enables you to put units back into service without undue delay.

Either "soaking" or circulating method may be used with the Oakite materials recommended for this work. Lime scale, rust, carbonized oil and other deposits are thoroughly, safely removed. Normal heat transfer efficiency is quickly restored at a significant saving in time.

Helpful data on this and other maintenance equipment cleaning are yours FREE for the asking. Write today.

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33 Thames St., New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Specialized CLEANING

Buy Bonds for Victory

sales . . . **Dresser Industries** moves its headquarters to Cleveland, Ohio . . . **Oster Mfg Co** appoints **Theodore S Bonnema** vice-president in charge of production and **Lester D Martin** treasurer . . . **Ross Industries Corp** elects **Allen R Cobb** to board of directors . . . **Carborundum Co** has named **F Jerome Tone, Jr.** vice-president in charge of sales and **W T McCargo** as eastern regional sales manager.

Timken Roller Bearing Co appoints **J Ringen Drummond** as assistant factory manager. New bearing and rock bit plant will be built by **Timken Roller Bearing Co, Ltd,** at St. Thomas, Ontario . . . **Robins Conveyors, Inc,** has made **Harold E Murken** controller and assistant secretary, **T Webster Matchett** as secretary and **John T Hoyt** as treasurer . . . **Mixing Equipment Co** announces changes in their sales organization: **Emerson Scheuring Tank & Mfg Co** of Indianapolis, Ind., will act as representative for central Indiana, **White Industrial Sales & Equipment Co** of Cincinnati, Ohio, for southern Ohio, northern Kentucky and western part of West Virginia, including Charleston.

Joshua Hendy Iron Works announces appointment of **Clarence F Jensky** to head a newly created turbine sales div. **Perry J Collonge** will assist him. To handle West Coast postwar business, **Sunnyvale** sales dept has reopened its San Francisco sales office at 544 Market St. with **Morris Levit** in charge . . . **G C Rasey** has been named supervisor of marine and stationary diesel div of general sales dept at Sunnyvale, with **Lawrence H Earle** and **Louis Kaiser** as his assistants . . . **Dean Swift** announces opening of offices in Chanin Bldg, New York City. He will represent **Western Gear Works'** plants at Seattle, Wash., Lynwood and Vernon, Calif., and Western Gear's associate plant, **Pacific Gear & Tool Works** of San Francisco.

Fisher Governor Co has named **Malcolm W Black & Co** as its representative in metropolitan New York and surrounding territory, including Connecticut and northern New Jersey . . . **Burndy Engrg Co** appoints **F L Gemmer** as advertising and sales promotion manager and **Eric E DeMarsh** as chief field engineer . . . **S M Rust** becomes board chairman and **S M Rust, Jr.** president of **Rust Engrg Co.**

Richard W Seaman has been named purchasing agent at Kearny plant, **Emark** div of **Thomas A Edison, Inc** . . . **Littelfuse, Inc,** opens New York office and appoints **Jack D Hughes** as eastern div sales manager . . . **Wabash Appliance Overseas Operations,** 401 Broadway, New York City, are in charge of sales and distribution of Birdseye reflector lamps and infra-red lamps for export . . . **General Electric Co** appoints **George E Simons** advertising and sales promotion manager of air conditioning and commercial refrigeration div . . . **W Paul Jones,** vice-president in charge of refrigerator div of **Philco Corp,** has been elected chairman of OPA domestic-mechanical-refrigerator-industry advisory committee . . . **I-T-E Circuit**

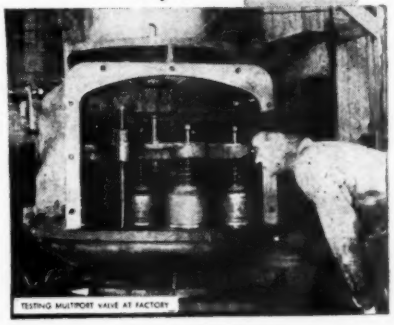
Why they Last and last and Last

The Cochrane Multiport Relief Valve is popular not only because of its remarkable service, but because of its long, trouble free life.

COCHRANE
MULTIPORT RELIEF VALVES

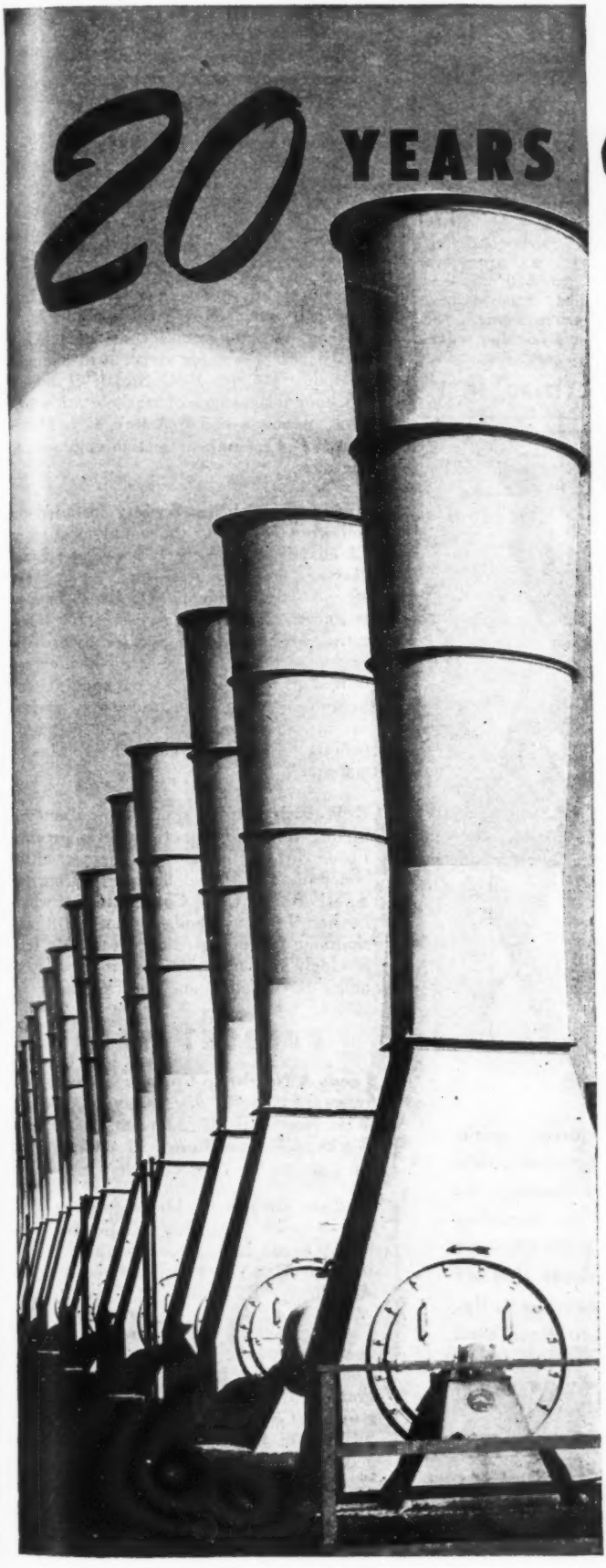
In many plants all over this country Cochrane Multiport Back Pressure Relief Valves have been operating continuously for ten, twenty, twenty-five years—and longer—without replacement of a single part. The care, the skill, the close precision to which this remarkable valve is built, are some of the reasons.

Write for Publication 4150

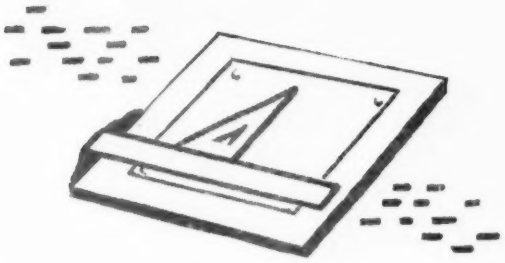


TESTING MULTIPORT VALVE AT FACTORY

COCHRANE CORPORATION
3106 N. 17th St., Philadelphia 32, Pa.



OF STACK DESIGN



SINCE 1924 the service given by thousands of "Thermix Fan Stacks" has proved the soundness of their unique basic design.

Advantages of combining the stack, fan and breeching in a single unit make possible an accurate determination of stack efficiency under any given condition.

Draft losses from bends in breeching are eliminated thus minimizing stratification. Gases leaving the fan enter the divergent stack directly where gradual diffusion occurs until the gas is discharged into the atmosphere. "Impact resistance" is thus reduced.

Installation problems are eliminated by the exclusive "Thermix Fan Stack" design which permits direct mounting on the boiler. Breeching to the stack is unnecessary —installation and material costs are reduced proportionately. Write for the bulletin on Thermix Stacks.

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THERMIX ENGINEERING COMPANY

Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

Put "AMBEST" to a long life test on any tough job

EUREKA

This UNIVERSAL packing — of long, pliable, anti-friction metallic alloy strands — assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F.— is recommended for pumps, compressors, engines, throttles and valve stems. All needs are supplied by one packing when you use "AMBEST."

Write for Working Sample
Send for 36 page catalog

EUREKA PACKING CO., 294-296 46th St., BROOKLYN 20, N. Y.

TUBE CLEANER

would YOU use?

Do you have some special tube-cleaning problem—scale that's hard to remove, that involves too much cleaning time—trouble in getting the cleaner around short-radius tube-bends—damage to tubes being cleaned? If you have these or any other tube-cleaning difficulties, you should get a copy of the Wilson Tube-Cleaner Selection Guide. It will help you choose and use the best cleaner for each job—to get the job done faster and more economically. It has some worth while hints on how to reduce maintenance and make cleaners last longer.

A copy of the Selection Guide—and a 36 page bulletin describing a complete line of cleaners for practically every kind of deposit in all sizes of ferrous and non-ferrous tubes—will be sent upon request and without obligation.

wilson
PIPE AND TUBE CLEANERS EXCLUSIVELY

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

Breaker Co appoints **J Fred Getz** manager of Washington, D. C., office . . . **Federal Telephone & Radio Corp** has named **Frank O Zimmerman** assistant manager of Chicago sales branch.

Westinghouse Electric Supply Co announces appointments of **J C Gross** as eastern district stores manager, with offices in New York City, and **R H St. John** as manager of Albany branch. **Alger Reilly** has been transferred to Newark branch. **David M Salsbury** has been elected vice-president and general manager. **Westinghouse Electric & Mfg Co** appoints **R W Beil** as general contract manager. **C F Lloyd** has been made assistant to manager of industry dept. **P C Smith** is named assistant to manager of transportation and generator div and **J S Askey, G L Moses** and **P G Lessman** as section engineers in the dept.

American Welding Society installed the following officers at the anual meeting in Cleveland: **A C Weigel,** president; **Isaac Harter,** first vice-president; **W F Hess,** second vice-president; **O B J Fraser,** treasurer; **M M Kelly,** secretary. **Ordnance Distinguished Service award** was presented to the Society at its opening session, "in recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of ordnance material."

E R Fish retired from **The Hartford Steam Boiler Inspection & Insurance Co** on Nov. 1. He was chief engineer of the boiler div. On Dec. 1 he retired from the **ASME Boiler Code Committee,** of which he had been a member since 1918 and chairman for the past three years. Mr Fish is widely known for his work in the field of boiler construction and insurance.

CURRENT AWARDS

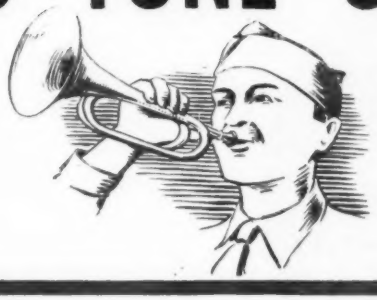
Leeds & Northrup Co has received fourth renewal for its "E" flag. **Solar Mfg Corp's** West New York, N. J., plant and Sharon Works of **Westinghouse Electric & Mfg Co** have received the same honor.

Buffalo Forge Co added a third renewal star to its "E" flag. **General Controls Co** and **Askania Regulator Co** won a second renewal. **Vita-Var Corp** has received the Army-Navy "E" award.

Passaic plant of **U. S. Rubber Co** has been awarded the Army Air Forces Quality Control Rating, highest production award granted by AAF. Plant No. 1 of **Aeroil Burner Co** wins Army-Navy "E" award. "R" div of **Electric Machinery Mfg Co** gets Maritime "M" award.

National Assn of Fan Mfrs, believing that the public is interested in terms and definitions now in common use in the fan industry, has published "Table 10—Names and Definitions of Types of Fans, Supplement No. B to Form X-12." Four general types of fans are illustrated and defined as (1) propeller fan (2) tubeaxial fan (3) veneaxial fan and (4) centrifugal fan.

LET'S TUNE UP FOR POST-WAR WORK



Check up
WAR-TIME ENGINEERING

Scores of ideas for plant improvement are given in the Sarco Hook-up Book.

One phone call and a few inexpensive, quickly installed Sarco steam traps and temperature controls can correct the many inefficiencies due to war-time engineering and lack of help or equipment in the time allotted.

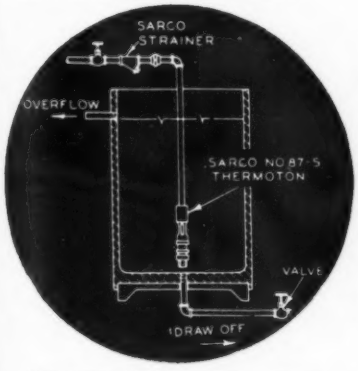
First consideration should be given to drips on steam lines and suitable traps and temperature controls for heating and cooling systems.

Increase
PROCESS CAPACITY

Sarco No. 9 thermostatic steam traps on each coil increased the capacity of this bottling machine.

The right steam traps and controls will make steam coils larger in output, your fuel and water bills smaller. This is substantiated by statements of Sarco users. It is the reason why all Sarco-equipped plants are ready for competition. Put one steam trap on each coil. Ask the Sarco representative about simple, inexpensive forms of heating and cooling controls.

Insure Service
ON WASHING TANKS

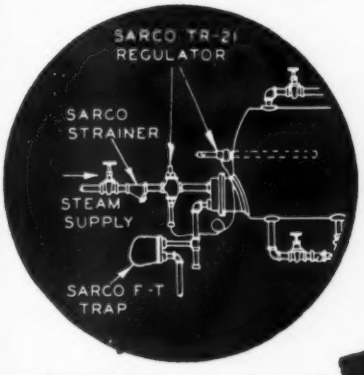


The Sarco 87 S acts like a steam injector, controls temperatures in tanks and other processes.

Tons of water and fuel are saved every day by controlling temperatures in wash tanks. Output is speeded—quality of product improved—continuity of production insured.

41

Improve
HOT WATER SERVICE



Sarco steam traps and control regulate the hot water supply.

Control temperatures at the source of supply for showers, process hot water and storage tanks with Sarco temperature control.

STEAM HOOK-UPS

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

just .001 of an inch from DESTRUCTIVE WEAR

● The Oil Film that protects the metal surfaces of the operating parts of a Turbine is only .001 of an inch thick. This means that abrasive particles *smaller than the eye can see* will cause destructive wear on moving parts, reducing efficiency and causing shutdowns for repairs.

THE viscosity of oil must be maintained at its original specification. Sludges change the viscosity and prevent the proper flow of oil through the lubricating system. Sludges also clog cooler pipes and interfere with heat transfer and proper cooling of oil.

. . Does Your Oil Purification Equipment Remove All Abrasives and Sludges from the Oil?

ACIDITY in Turbine Oils aids oxidation of the metal structure, it increases the tendency of the oil to emulsify. Any attempt to remove this acidity by chemical reaction generally magnifies the very difficulty it is intended to correct.

. . Does Your Oil Purification Equipment Control the Acidity of the Oil Within Proper Operating Brackets?

Most types of Oil Purification Equipment can not meet these requirements but *Honan-Crane Oil Purification can.* Honan-Crane Oil Purification will remove even the most microscopic abrasive particles, it will remove sludges and it will allow you to maintain the neutralization number within the desired operating bracket. It does its work while the turbine is in operation and removes the contamination as fast as it is liberated by the operating turbine.

★ Write today for Engineering Bulletin on the Purification of Turbine Oils and for Equipment Data on Honan-Crane "Continuous" Oil Purifiers.

Honan-Crane
CORPORATION
1200 SIXTH STREET LEBANON, INDIANA

SUBSIDIARY OF HOUDAILLE-HERSHEY CORPORATION

OBITUARIES

Robert F Gifford, 56, whose career embraced a wide variety of engineering work in power-plant construction in Siberia and service with General Fire Extinguisher Co, Installation Engineering Co, Shaw-Perkins Mfg Co, Thermal Engrg Co, Stone & Webster Engrg Corp and E B Badger Co, died in Boston on Dec 2. He was a mechanical engineer graduate of Worcester Polytechnic Institute.

Bernhard E Reske, 73, retired stationary engineer, died Nov 25 as a result of an automobile collision. He resided at Marshfield, Mass.

S R Bergman, 67, consulting engineer in Thomson laboratory of General Electric's Lynn (Mass.) River Works, died Nov 25.

Howard Gay, 51, secretary and cost department manager, Macwhyte Co, died Nov 23 at Kenosha, Wis.

Henry Ellsworth Harris, who founded and was head of Harris Ice Machine Works in Portland, Ore., died Nov. 5. He was past president and charter member of National Assoc of Stationary Engineers and past vice-president of National Assoc of Refrigeration Engineers, Oregon division.

Joseph L Vergilio, founder and owner of J L Vergilio Co, Cleveland, died Oct 17. He was active in Cleveland Engrg Society and a member of American Institute of Electrical Engineers.

Walter W Mohr, 48, member of engineering staff of Edward Valve & Mfg Co for 24 yr, died Nov 13 at St. Margaret's Hospital, Hammond, Ind.

J W Sullivan, 73, chairman of board, Skilsaw, Inc, died Oct 26 at his home in Evanston, Ill.

POWER's History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam,* which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry,* which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers and Steam Electric Magazine.*

In 1908 POWER absorbed *The Engineer's Review, of Cleveland,* and *The Engineer,* of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering and The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. All rights to the preceding titles reserved.

ROTA-SIGHT FLOW ALARM

gives positive protection against flow failure!

LIKE A TAUT SENTRY in the dark, this new flow alarm always stays on the alert. "*Advance, Flow, and give the countersign!*" If too low or too high, wham goes the big bell or swiftly a solenoid valve moves to a new position. Your product and your equipment will be surely and safely guarded by the Rota-Sight Flow Rate Alarm.

It is made with a transparent, V-ported metering tube, and a metal float which moves up or down *in direct response to flow rate changes only.* The float has a magnetic extension which trips an external switch to operate the alarm circuit. It responds equally well to flows of liquids or gases. Easily made explosion-proof.

The Rota-Sight Alarm is cast in all metals in sizes from ½" to 6". Without the alarm, it is an inexpensive, compact indicator of the true flow rate.

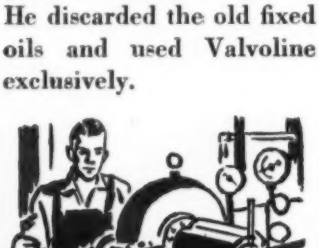
The Rota-Sight and Rota-Sight Alarm have been rapidly adopted by the leaders in the process industries and the equipment manufacturing Companies for measuring coolants, "lube" oils, chemical feeds, etc., to diesel engines, air compressors, turbines, filters, furnaces, stills, heaters, reaction vessels, etc. It has answered their needs for a positive, sure-fire flow rate indicator and alarm.

The interesting details are given in Bulletin 92-B—write for it on your Company letterhead.

FISCHER & PORTER CO. 6001 County Line Road HATBORO, PA.

in 1866

Valvoline was the *first* and only mineral oil adopted by George Corliss — the great steam engine builder. He discarded the old fixed oils and used Valvoline exclusively.



and TODAY

Men who build steam engines whose power and speed Corliss could never have imagined—still agree with his choice of the unquestioned BEST in steam cylinder oils . . .

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The Finest
Lubricating Oils Since 1866

Write for complete information on Valvoline Turbine Oil, Diesel Oil, and Cutting Oil.

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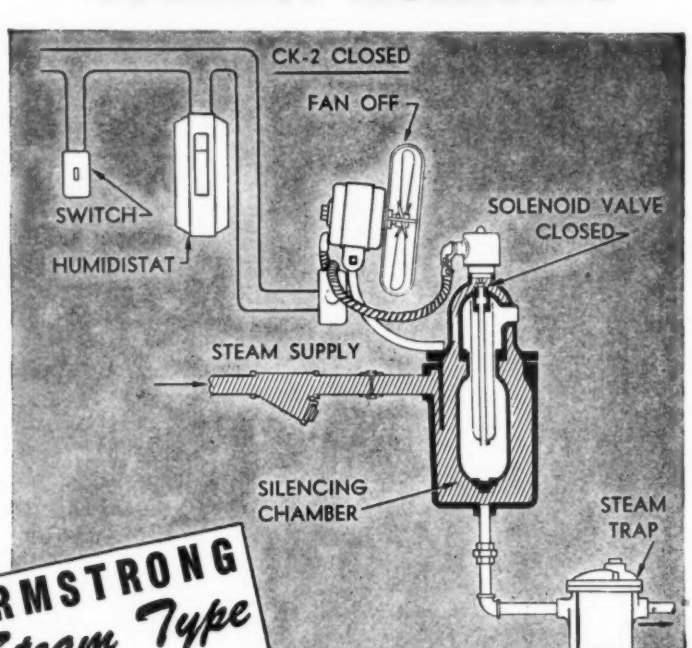
HERE'S THE *Newer, Better* WAY TO MAINTAIN CORRECT HUMIDITY



ARMSTRONG *Steam Type* UNIT HUMIDIFIERS

What Armstrong humidification will do for you!

- Prevent drying out of material and prevent loss of weight and strength.
- Improve workability of materials.
- Help reduce fire and explosion hazard throughout control of static.
- Provide more healthful working conditions.

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Contains data on humidity, steam type humidification, charts, diagrams, pictures. Educational, informative. Write today.

Now you can have the benefits of controlled humidification easily and economically. Electrically operated Armstrong steam type humidifiers maintain desired humidities within close limits.

The first cost is low. One hundred dollars invested in the Model CK-2 buys humidification for as much as 40,000 cu. ft. of space. That's complete with all accessories including sensitive Friez humidistat. Multiple installations meet any requirements. Larger models also available. Installation cost is low. The humidifier connects into existing steam lines like a unit heater. The operating cost is low. Steam required for the Armstrong humidifier is available in most plants for less than $1.00 per ton. There is an Armstrong representative near you. Let him give you complete information. Write today for his name.

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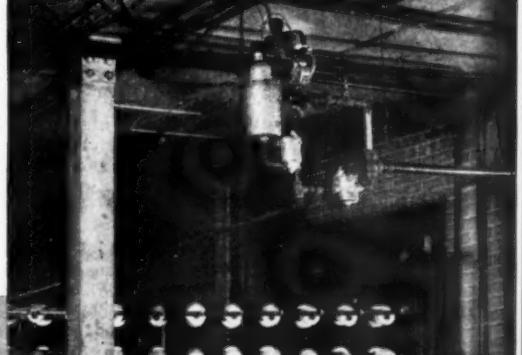

Are you basing Power Plant Plans on a Coal that doesn't exist?

Why not let KNOWN FACTS* . . . *be your guide*

While your new power plant is in the "dream stage", make a thorough FUEL INVESTIGATION.

The fuel study will reveal the coal which should be used as a basis for the design of new combustion equipment. If this study is not made first, it may develop that the coal you expect to use will soon be exhausted and actually WON'T EXIST for the full life of the plant.

Equipment designs should be sufficiently liberal to permit the use of a wide range of coals so that the new plant will not be in a "strait-jacket" requiring specialty or premium coals with limited reserves.

FAIRMONT COAL satisfies the fundamental requirements of the fuel investigation for most eastern markets, and is used as the design basis for many new and modernized steam plants. The "known facts" developed through the fuel study will be the guide for a modern plant which can burn the desired range of coal quality available, and enable the purchase of the best value for the fuel dollar during the plant's life.

We suggest that you consult the fuel engineers of the Fairmont Coal Bureau before proceeding further with your new power plant, or with the modernization of your existing equipment. You will be interested in the data contained in the Coal Reference Bulletins, which specialize in information not available from other sources.

FACTS ABOUT FAIRMONT LOW FUSION COAL

- . . . can be burned efficiently and economically in any equipment properly designed for its use.
- . . . it will be available for many years to come because of its huge reserves.
- . . . it is available on three originating railroads.
- . . . it usually represents "the best value for the fuel dollar" for long-range planning.

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It is not only unpatriotic to use more coal than you need—and deprive others of necessary fuel—but wasted coal costs you money. It is a fact that FREDERICK Industrial Stokers have saved users hundreds of tons of coal in a single year.

- The fully active grate surface
- Continuous speed type transmission
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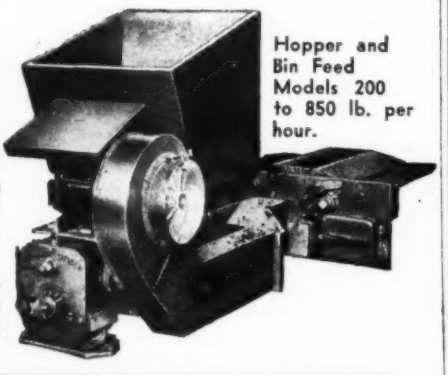
plus other FREDERICK engineered features,* give maximum combustion efficiency with minimum service and maintenance—and result in lowered fuel consumption.

* Our new Stoker catalog enumerates additional reasons why you should use FREDERICK Stokers. Send for it now . . . no obligation.



Hopper and Bin Feed Models 200 to 850 lb. per hour.

ALSO KEEP IN MIND—For over 25 years FREDERICK has been making fine Centrifugal Pumps, guaranteed to meet the operating conditions for which they are sold. Write for full information.

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STOKER SPECIALISTS SINCE 1918

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Eliminates Soot and Fire-scale without chipping or scraping

Manual chipping of fire-scale and scraping soot from boiler heating surfaces wastes valuable time and labor, and ties up the unit.

Simply feed Xzit into the fire-box while your boilers continue to operate, and all accumulated fire-scale and soot will be reduced chemically so they can be dissipated by natural draft or blowing, without chipping or scraping.

Xzit stops sparking and extinguishes stack fires instantly. Periodic use keeps heating surfaces clean, saving fuel and reducing maintenance.

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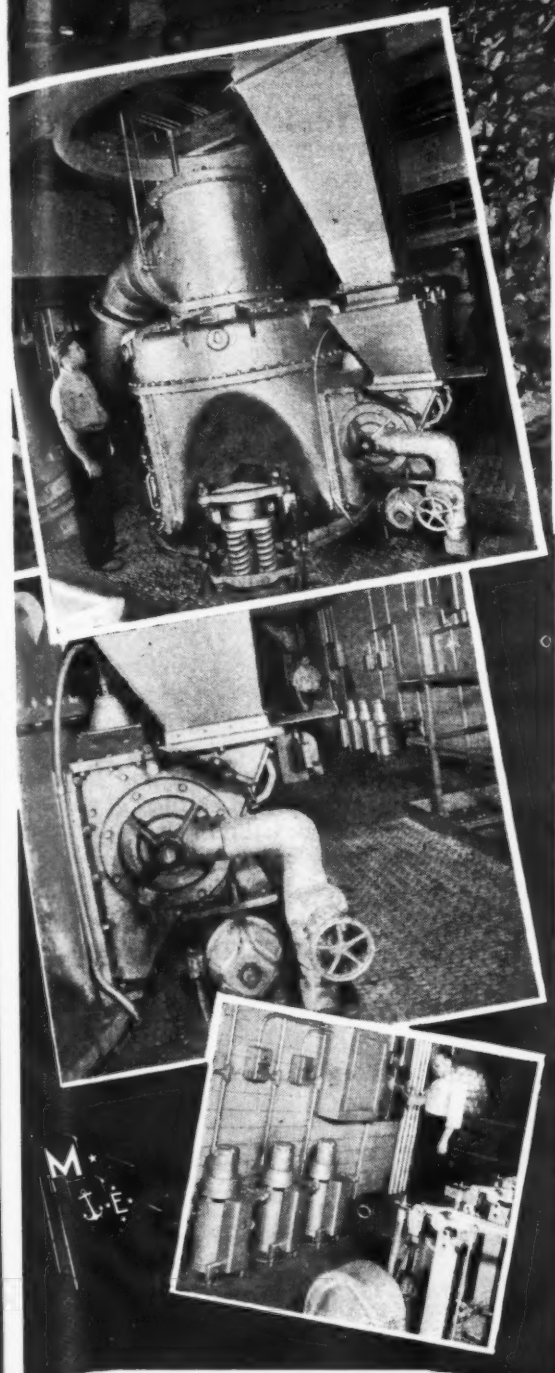
"MOTOR-DRIVE IS MORE THAN POWER"

RELIANCE V★S DRIVE



V★S DRIVE CONTROLS COAL FEED *for Constant Steam Pressure*

THE AMOUNT OF COAL fed into each of six 14-ton-per-hour mills in this power company installation is controlled by a Reliance V★S Drive,—a system of D-c. Motor and control unit, operating directly from the A-c. power lines. No auxiliary D-c. circuits are necessary.

The speed of the motor, which drives a rotary feeder, is increased or decreased according to the output of the V★S control unit which, in turn, is regulated by the steam pressure in the boiler. Since the output of each boiler is determined by the amount of coal coming from the mills, the V★S Drive plays an important part in helping to maintain steam pressure at the desired constant level. The system is giving highly satisfactory results and requires a minimum of attention.

"Reliance V★S" is an all-electric, adjustable-speed drive for A-c. circuits, through which a wide variety of operations can be controlled electrically. It has proved its efficiency and reliability in numerous installations. If you would like to know more about its possibilities, we suggest calling in a Reliance Application Engineer.

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Each of the 14-ton-per-hour mills (upper photo) serves one 500,000 pound-per-hour boiler. Amount of coal fed into each mill, and thence to its boiler, is regulated by a Reliance V★S Drive unit, three of which are shown in above illustrations.

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Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

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The De Laval-IMO pump for fuel oil and "lube" oil services is distinguished by compactness and simplicity. There are only three working parts which are in complete hydraulic and rotational balance and which propel the oil without pulsation, like a piston moving steadily forward. There are no valves, no gears, no cams and no reciprocating parts. The one packing is under suction pressure only and is easily accessible. Any quantity of oil is delivered against any pressure.
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IMO PUMP DIVISION
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Self-Lubricating **PACKINGS**

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MIDWEST "STANDARD" BUTT-WELDING ELBOW

MIDWEST "LONG TANGENT" BUTT-WELDING ELBOW

. . . . and ONLY MIDWEST offers THIS CHOICE

Before you select welding elbows to use on any given piping job, it will be worth your while to consider the relative values of the two elbows shown. On some jobs the correct selection can mean a real saving of time and money. Only Midwest offers you the choice of either type elbow . . . and there is no difference in price.

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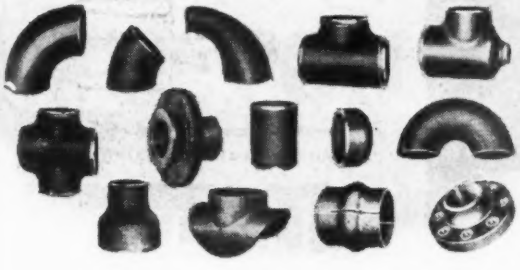
Both elbows have all advantages of the unique Midwest manufacturing process: final working of the metal in compression (which means exceptional dimensional accuracy and uniformity), stress relieving, exact included angle, true circular section and uniform wall thickness.

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS



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Roto Tube Cleaners can help you maintain maximum performance and efficiency of your tubular equipment with minimum expenditure of time and labor.

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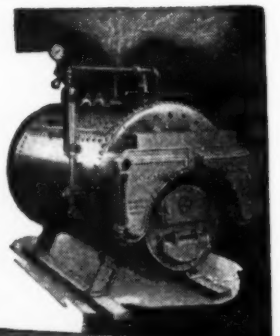
SCOTTIE JR BOILER

5 sizes for small industrial usage. 9.9 to 30 H.P. Conveniently compact, yet easily accessible. Low in cost—economical to operate.

75 Years Boilermakers



For 6" scale with pipe diameter marking, write Department 99-K1

KEWANEE BOILER CORPORATION Kewanee, Illinois

High Pressure Steam at Low Cost

Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

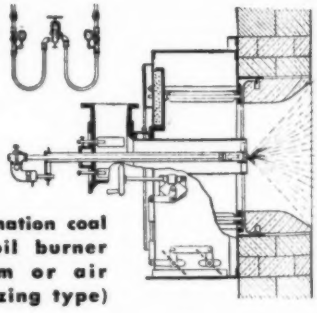
Enco OIL BURNERS

have these 7 ADVANTAGES *in pulverized coal fired boilers . . .*

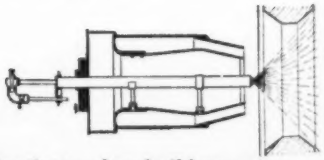
They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- **They warm up cold furnaces**
- **They ignite pulverized coal—safely**
- **They assure continuous operation in case coal system fails**
- **They provide efficient and safe operation on bank and at low loads**
- **They respond almost instantly to sudden load changes**
- **They permit operation with oil or coal—whichever is available and lowest in cost per BTU.**
- **All capacities of steam, air or mechanical-atomizing types are interchangeable**

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.

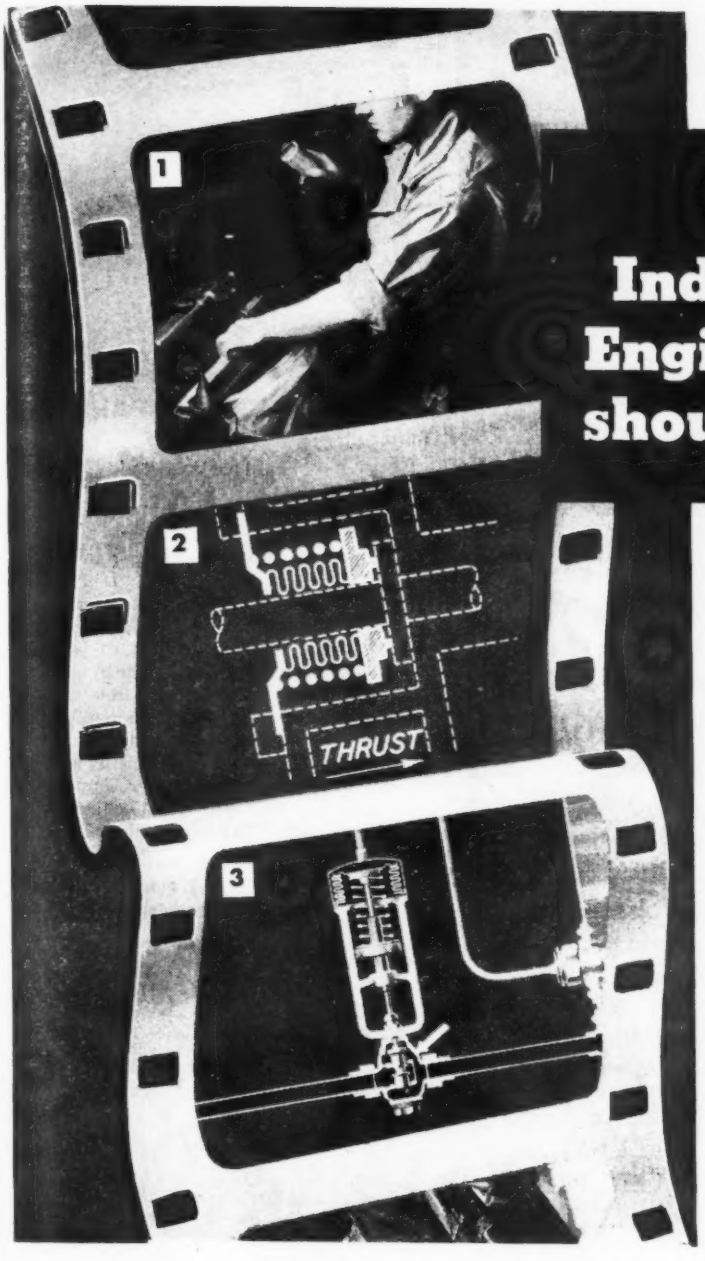


Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners



Every Industrial Executive, Engineer and Designer should see this picture

SIMPLE as bellows are, words often fail to show the limitless design possibilities inherent in these versatile metal diaphragms. Too often many engineers have assumed that bellows only had application in a few fields, when actually they have been successfully applied to scores of designs in dozens of different industries.

"*The Story of Metal Bellows*" is an interesting and informative sound film, vividly showing the basic application characteristic of a Sylphon Bellows. It shows just how a bellows converts pressure and temperature changes into controlled mechanical movement, and demonstrates graphically how this movement is harnessed to perform innumerable tasks.

This picture is one of the most thought-provoking industrial films ever produced. We are sure your organization will find it stimulating. Let us know when it will be convenient to have this 28-minute sound film shown to your group, at no cost to you. 16 MM or 35 MM film available.

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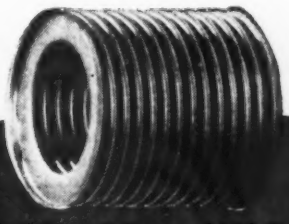
2. Fundamental applications of bellows are shown in animation . . . may suggest how you can profitably employ Sylphon bellows.
3. This portion of the film explains the operating principle of various types of temperature controls.

FULTON  **SYLPHON**

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"Its Strength Increases as Temperature Rises"

ADAMANT has a bonding strength of 800 pounds per square inch at room temperature and 1270 pounds per square inch at 2600° F. ADAMANT has a P. C. E. of 3000° F. Plus.

This exceptional bonding strength is the reason why ADAMANT keeps furnace linings in service longer. Write for further details.

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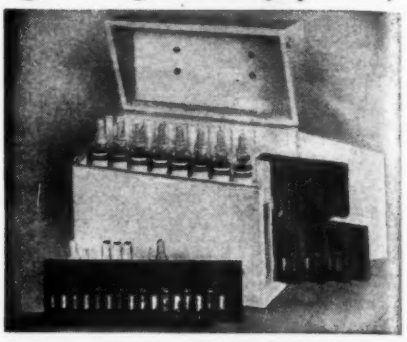
TAYLOR-*Standard of Accuracy*



LONG RANGE COMPARATOR

Big Help
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Price, complete with any 3 slides.....$42.00
F. O. B. Baltimore. Extra slides, each..$8.00

DALITE pH Comparator

Just the outfit for all routine testing. A completely self-contained unit for immediate use night or day. Neat wooden carrying case contains model T-O comparator base (which sits on shelf in front of dalite glass) special bulb, any 3 to 8 color standard slides, and all accessories. Absolutely accurate, for all Taylor liquid color standards carry an UNLIMITED GUARANTEE against fading.

Dalite pH Slide Comparator, complete with 3 color standard slides.$50.50 F.O.B. Baltimore

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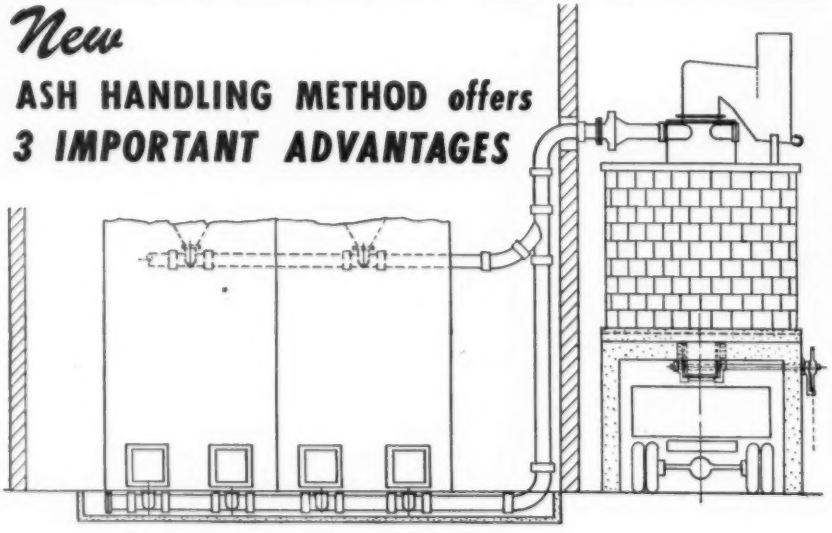
"Modern pH and Chlorine Control"

W. A. TAYLOR AND CO.
• YORK & ROGERS FORGE RDS. • BALTR 4 MD

New
ASH HANDLING METHOD *offers*
3 IMPORTANT ADVANTAGES



In the Beaumont "Vac-Veyor" pneumatic ash handling system the exhauster, receiver, separator and air washer are combined as one unit. Operating advantages include: (1) All ash delivered into the silo, none into the air. (2) Ash delivered dry. No freezing or packing in silo. (3) Continuous operation, with low steam consumption. What are your ash handling problems? Send today for literature.

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DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

PUMP AND MOTOR BALANCED IN A SINGLE UNIT

. . . *for quiet operation, efficient service, long life*

When you buy a Worthington Monobloc centrifugal pump for water supply, boiler feed, circulation or one of its many other functions, you don't get just a pump hooked up to a conventional motor.

No sir! And here's why. We start with a rigid support. On one end we mount the correct Worthington *centrifugal* pump to do your job just right. On the other end—in perfect balance—we mount the correct motor to make your pump do its best work.

Here are the advantages: alignment is perfect and permanent . . . no shaft distortion . . . therefore longer life at lower cost.

Please don't misunderstand us. We don't tailor-make your Monobloc for you. That was all done in advance when Worthington became the first manufacturer to build a complete line of electric-driven *centrifugal* pumps of the Monobloc design that are truly balanced units—planned and mated *on the drawing board.*

Monobloc pumps range in capacities from 10 to 1600 gallons per minute . . . in heads from 15 to 500 feet . . . in motor horsepower from ¼ to 60. First cost is low . . . maintenance is negligible. For complete details of Monobloc's other exclusive features and operating benefits, write us or telephone your nearest district office or authorized dealer for Bulletin W321-B14.

180 pages of vital facts about centrifugal, power, rotary and steam pumps; air compressors, liquid meters . . . all conveniently tabbed for easy reading. Use coupon below.

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MONOBLOC Pump and Motor a Simple Balanced Unit

Centrifugal Pumps | Rotary Pumps | Steam & Power Pumps | Vertical & Horizontal Compressors | Liquid Meters | Variable Speed Drives | Multi-V-Drives

WORTH BEHIND THE NAME WORTHINGTON

CPL-18

Standard Products Division
Worthington Pump and Machinery Corporation
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Please send me complete Standard Industrial Products Catalog, including information on Monobloc *Centrifugal* Pumps.

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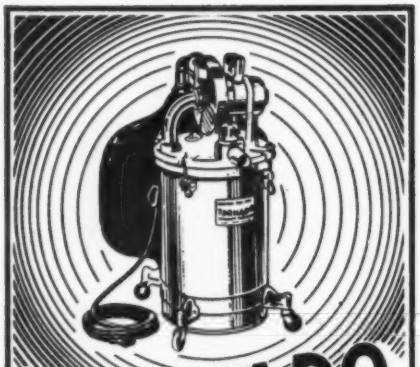

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PORTABLE INDUSTRIAL VACUUM CLEANER

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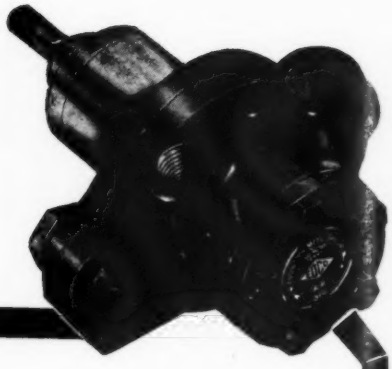
6-7 BALL BEARING **TORNADO**

PORTABLE INDUSTRIAL VACUUM CLEANER

EDCO ROTARY PUMPS



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PATENTED CONSTRUCTION

At high or low speeds . . . whether creating a 28" vacuum or developing extremely high pressures . . . the vanes of EDCO Pumps maintain effective spanning position without springs or centrifugal action.

Fuel transfer pumps, coolant pumps and motor-driven assemblies. Furnished in capacities from 2 GPH up, in any required corrosion-resisting material. Operates silently at all speeds. Minimum maintenance required. Used for fuel oils and other fluids of any specific gravity.

FOR COMPLETE DATA . . . write today. Ask for Bulletin 936.

EDDINGTON METAL SPECIALTY CO.
P. O. Box K **Eddington, Pa.**

The

COFFIN-Steam Turbine CENTRIFUGAL PUMPS

For Boiler Feed and general high pressure service

See previous issue for details

THE J. S. COFFIN, JR., Co.
ENGLEWOOD, N. J.

POWER HANDBOOK

56 pages (parts 1 & 2 combined), 50 cents, postpaid

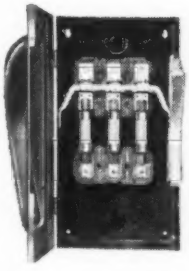
If convenient, cash with small orders will save red tape of billing. *Address all orders to POWER, 330 West 42 St., New York 18, N. Y.*

Addressed to practical power men, and written by Phil Swain, Editor of *Power*, the Power Handbook gives basic engineering data and figuring methods in simplest possible form—mostly plain arithmetic any grammar-school graduate can follow. Here are chapter headings:

PART 1 (Dec. Power, 1943)
- Weights & Measures
- Practical Mathematics
- Mathematical Tables
- Mechanics & Mechanisms
- Mechanics of Materials
- Fundamentals of Heat
- Steam Tables Simplified
- Practical Electricity
- Hydraulics & Pumping
- Piping, Flow & Tanks
- Engineering Economics

PART 2 (Feb. Power, 1944)
- Feedwater Chemistry
- Fuels & Combustion
- Steam Generation
- Turbines & Engines
- Diesels, Gas Engines
- Compressors & Fans
- Refrigeration Facts
- Heating,
- Air Conditioning

Distinguished!



Vacu-Break

SAFETY SWITCHES WITH "CLAMPMATIC" CONTACTS

There are many valuable *plus features* in BullDog Safety Switches, but none of them increases the *price you pay.*

There is the exclusive Vacu-Break principle of arc suffocation . . . the Clampmatic feature which assures "on" contacts as tight as a bolted connection . . . and the distinguished style of cabinets which combine modern beauty with extra utility.

Such advantages, backed by the BullDog reputation for invariably fine workmanship, account for the fact that a majority of buyers who insist on the *best* are among BullDog's customers.

Capacities from 30 Amp. to 1200 Amp., 2, 3 and 4 Poles, 575 Volts and less.

Buy More War Bonds

BULLDOG

ELECTRIC PRODUCTS COMPANY

Buy More War Bonds

BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN
In Canada: BullDog Electric Products, Ltd., Toronto
Field Engineering Offices in All Principal Cities

Also Manufacturers of

SaftoFuse Panelboards — Switchboards — Circuit Master Breakers—BUStribution Duct, for "plug-in" power—Universal Trol-E-Duct, for flexible lighting — Industrial Trol-E-Duct, for movable "loads."

Correct Solution to Power Piping Problems

Whatever your piping problem may be, Navco is in position to help you. The knowledge which we have gained in the past thirty-five years has not been confined to design and fabrication alone. It includes a wide field of experience in erecting and testing Piping Systems for every service.

NATIONAL VALVE & MANUFACTURING CO.
PITTSBURGH, PA.

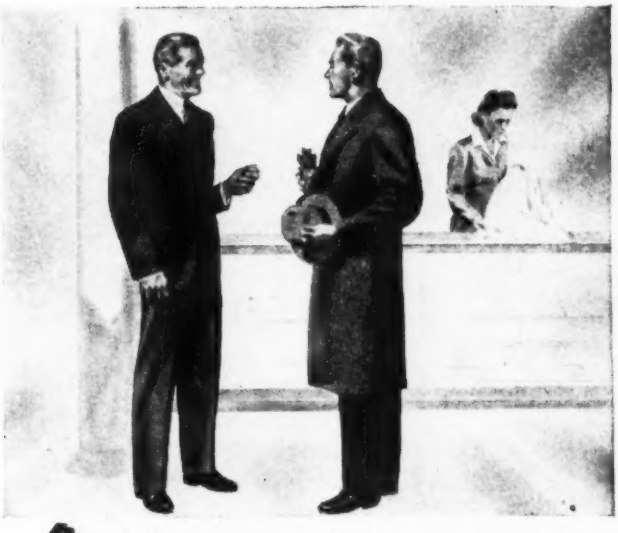
NAVCO

NAVCO PIPING

1. *A business man asks . . .*

2. *A professional man inquires . . .*

3. *An architect wonders . . .*



4. *A department store manager asks . .*

Does OTIS still make elevators?

Certainly! We've never been *out* of the elevator business, although our engineering and manufacturing facilities have been working 100% for the Armed Services.

It is true that we have manufactured vast quantities of parts for guns, ships and aircraft for the Army, Navy and Air Corps but, because vertical transportation is essential in the production and handling of munitions of war and in the operation of aircraft carriers, we have continued to produce a large volume of passenger, freight and special purpose elevators.

We have been too busy producing war goods to say much about the future — but

Now — representatives in our 244 offices are ready and waiting to work with architects, engineers, and owners in the preparation of surveys, plans and estimates on new elevator installations or the modernization, repair or maintenance of existing facilities.

Your action now will expedite future deliveries. Production will begin as soon as material and labor are no longer required for war goods.

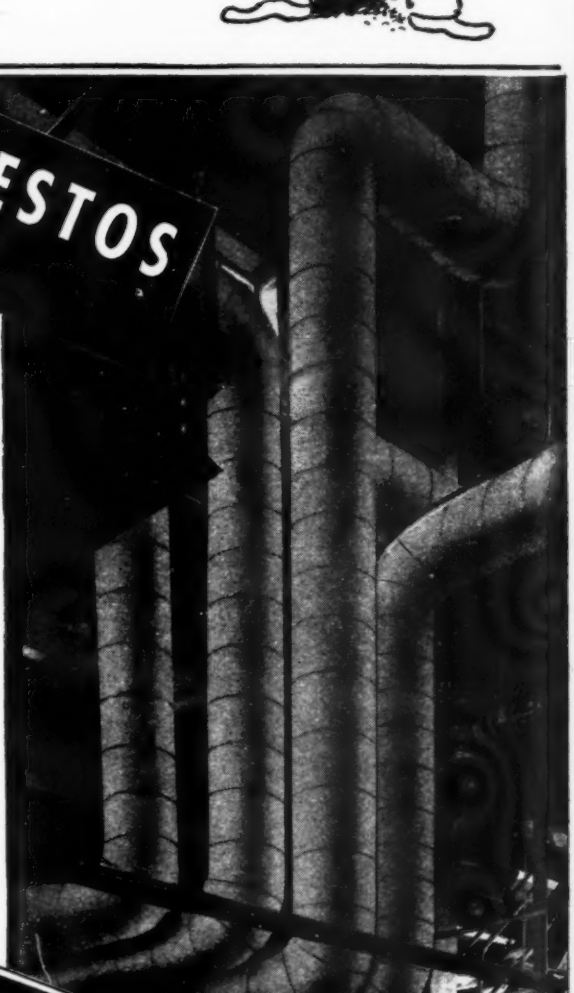
Otis ELEVATOR COMPANY
BRANCH OFFICES IN ALL PRINCIPAL CITIES

COMING OUT AT THE ELBOWS?

SIMPLY APPLY UNIBESTOS

it's simple to apply!

Unibestos, being sectional for virtually all size pipes, greatly simplifies the application of insulation to bends and elbows. You simply mitre sectional Unibestos to fit—the fibrous nature of the material used in Unibestos (amosite) makes for a more perfect seal; eliminates much of the need for filling in with plastic —requires only a *surface* application to finish it off in a neat, clean and efficient job.



UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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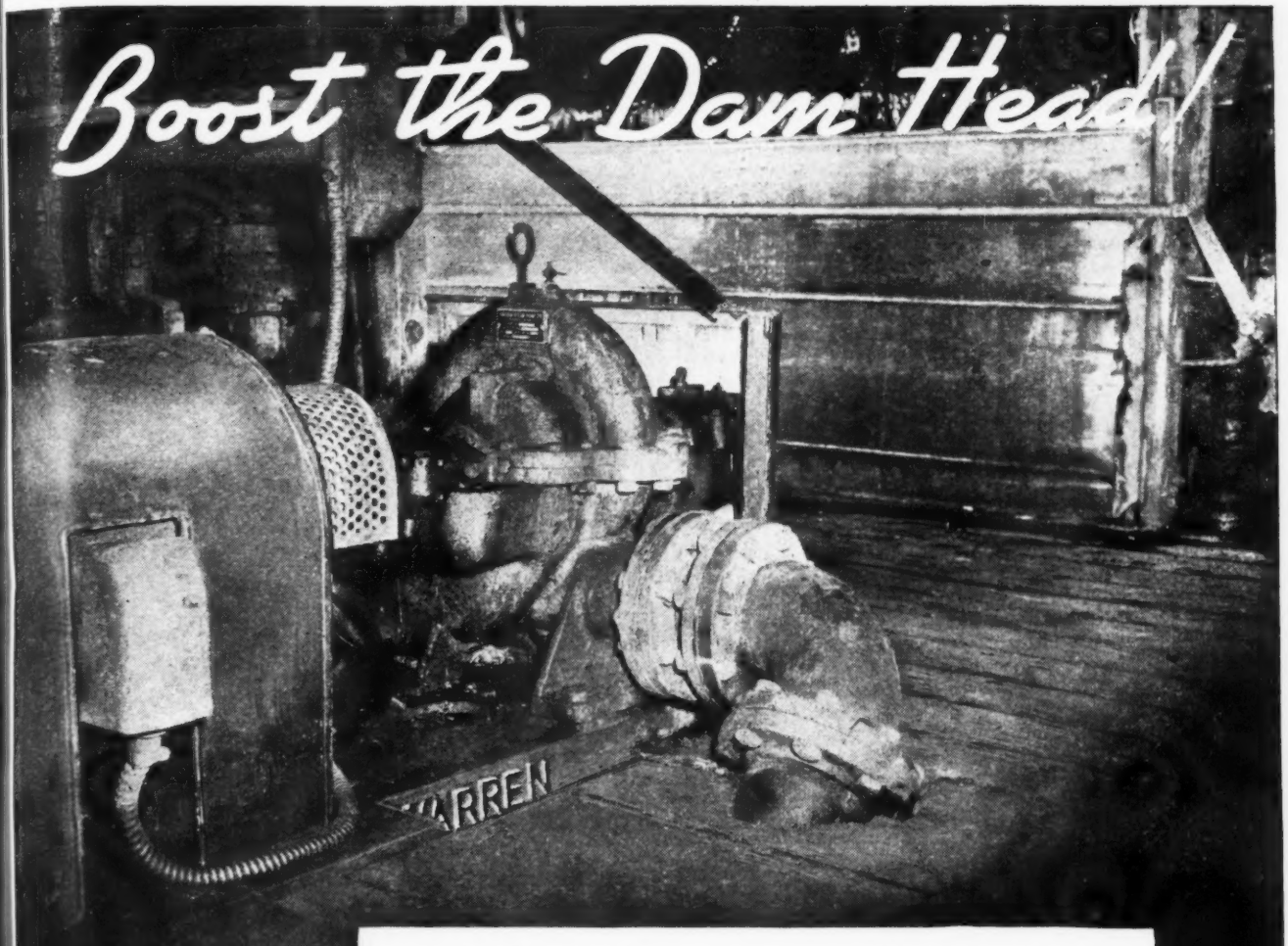
UNION ASBESTOS AND RUBBER CO

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

Boost the Dam Head!



One of three Warren Pumps on booster service at Uxbridge Worsted Co., Inc.

That was the water supply problem at Uxbridge Worsted Co., Inc., Uxbridge, Mass., successful operators of a dozen or more plants with an enviable reputation in the woolen and worsted field.

Water supply to the washers and kettles at the mills depended entirely upon gravity feed from the dam head. The supply was slow and inadequate.

Warren engineers were called into the picture — and three Warren horizontal, double-suction booster pumps were installed. Result: production on washers and kettles was boosted threefold.

Also used at Uxbridge Worsted Co., Inc., for boiler-feed and other services, are Warren reciprocating and two-stage turbine-driven centrifugal pumps.

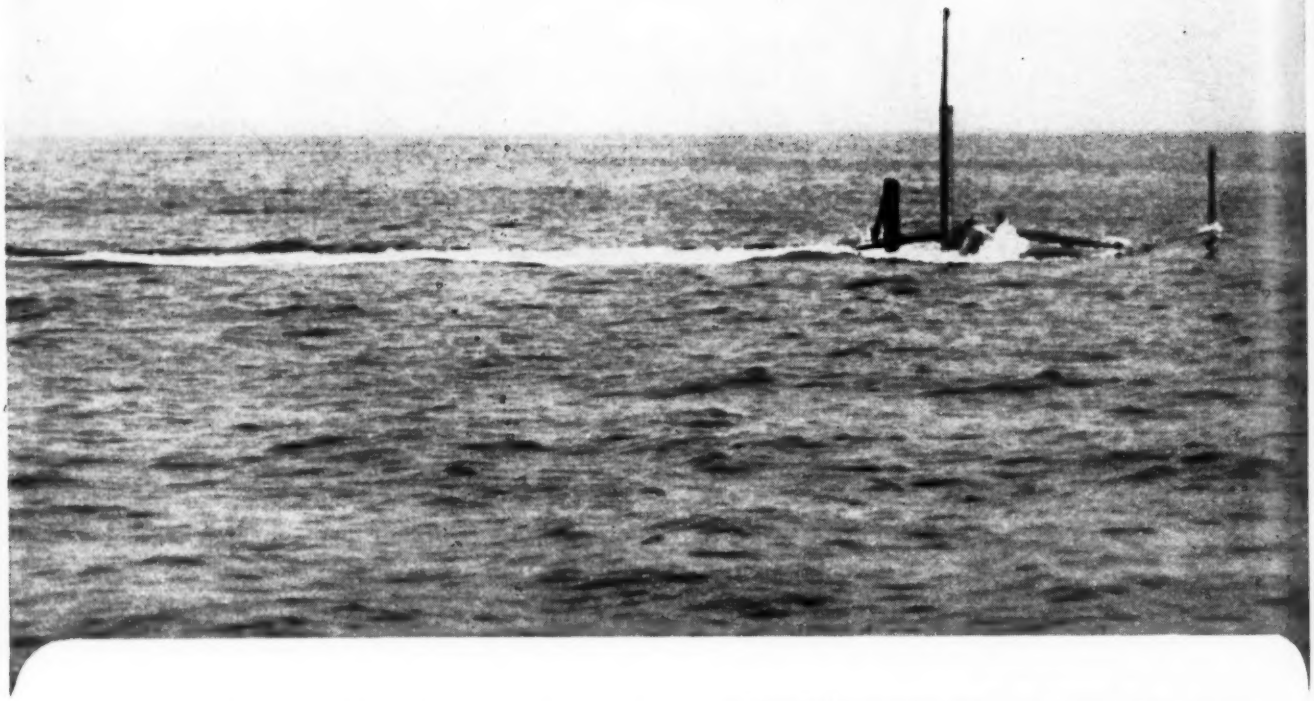
If there is a pumping problem troubling you, turn it over to Warren engineers.

ARMY E NAVY

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

HIDDEN *Water Hazards*



● Hidden Hazards . . . sponsored by Uncle Sam . . . are showing up in many waters with devastating results for the enemy.

Hidden Hazards . . . sponsored by Objectionable Dissolved Minerals or Chemical Instability . . . are showing up in many water supplies with just as devastating results for plant equipment and manufacturing processes.

In the latter case action is far from spectacular . . . that's why the Hazards are Hidden . . . but, in either case . . . the end results are the same.

Water that is conditioned to remove objectionable minerals, hardness, corrosion, oil, suspended matter, etc. will protect your production schedules, safeguard irreplaceable power plant equipment, save precious fuel and reduce labor costs.

The power plant, so vital to the war effort, can have the protection of Infilco equipment for boiler or evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, etc. . . . as well as Infilco chemical feeders and trade waste treating equipment. You are invited to make use of Infilco's 49 years' experience in these allied fields. Call on our Engineering Staff. There is no obligation.

INFILCO

INCORPORATED

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INFILCO

ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
WATER FILTERS • CLARIFIERS • COOLING WATER CONDITIONERS
CONDENSATE FILTERS • STEAM PURIFIERS • HOT-FLOW SOFTENERS
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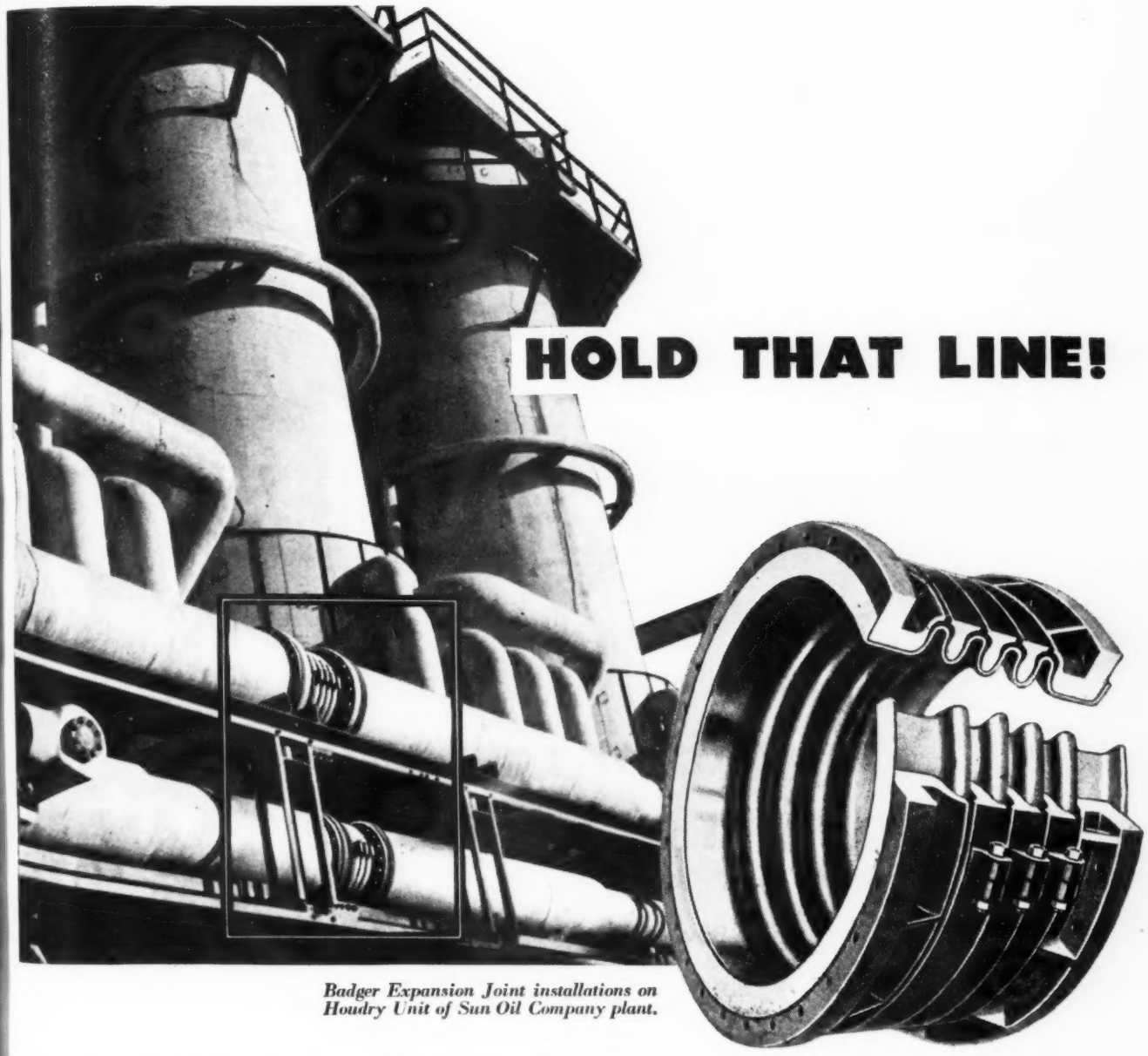
ARMY E NAVY



Badger Expansion Joint installations on Houdry Unit of Sun Oil Company plant.

SELECT the right Badger Self-equalizing Corrugated Expansion Joint for the line's length and maximum temperature, and DIRECTED FLEXING will keep the joint functioning long and efficiently.

***Directed Flexing,** through the combination of ALL-CURVE corrugations and ALL-CURVE equalizing rings, is exclusive in Badger Joints.*

First, because of their ALL-CURVE design, the corrugations in Badger Joints are less subject to localized stresses than corrugations having straight sides and "junctions."

Secondly, flexing is *directed* and progressively controlled by correspondingly shaped Badger ALL-CURVE Equalizing Rings. These rings do two jobs: They help to distribute the stresses evenly over the whole contour of each corrugation and also evenly among the corrugations.

Packless and Compact. Being formed from a single piece of tubing — by a special Badger process that does not appreciably thin or otherwise weaken the metal — these superior expansion joints require *no packing*. Therefore they require no packing maintenance. They also save manhole expense in underground installations. Being compact, they waste no space — take up no more room than a comparable flanged fitting.

Badger Self-equalizing Corrugated Expansion Joints are made in copper for normal pressures and temperatures; in stainless steel for higher requirements — and where corrosion is a problem; with single and multiple corrugations — to take care of traverses ranging from a fraction of an inch upward. Also made in Non-equalizing type for pressures and traverses that do not require the added protection of equalizing rings.

FREE BULLETINS: ***No. 100 for Self-equalizing; No. 200 for Non-equalizing.***

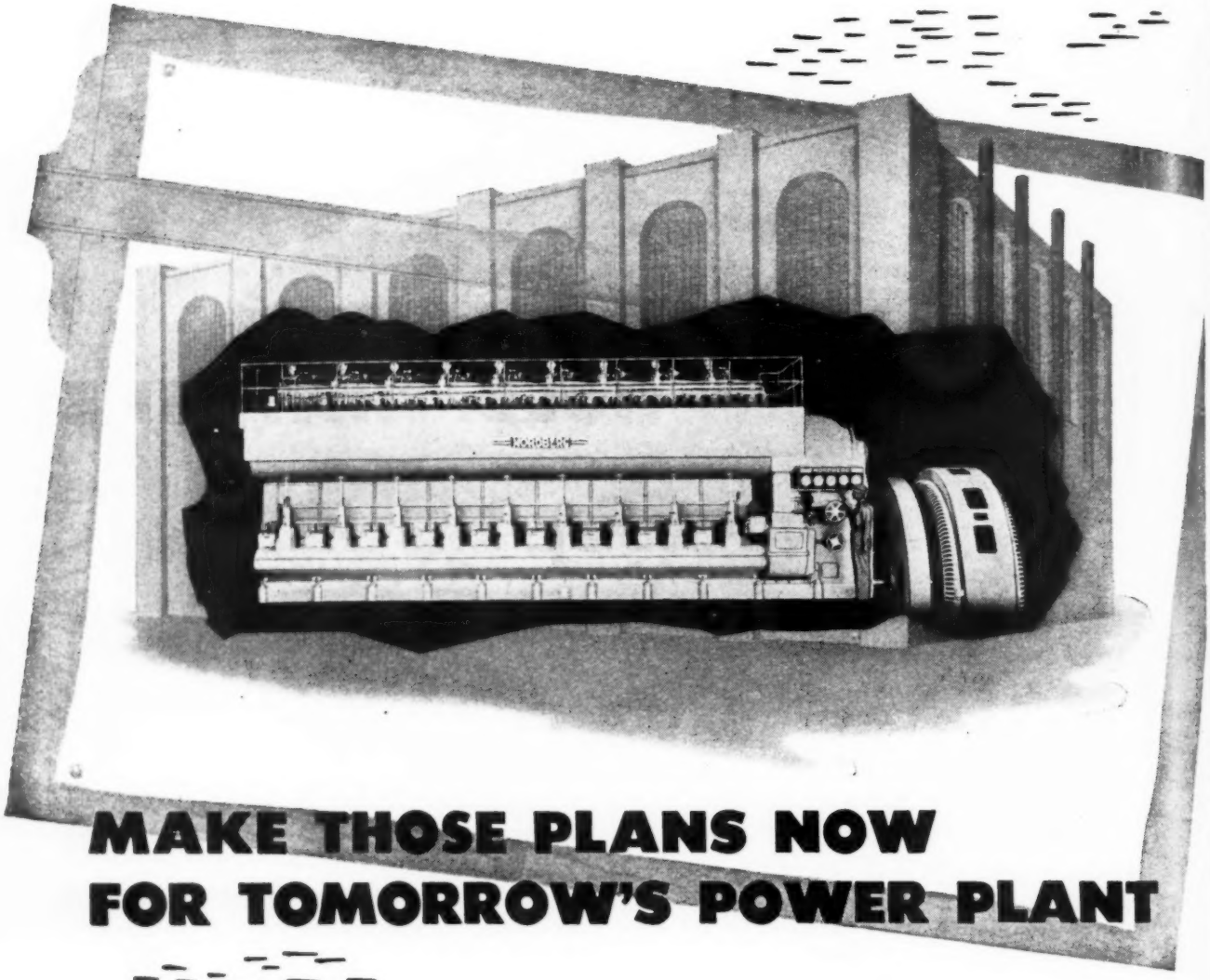
E. B. BADGER & SONS CO. • 75 Pitts Street, Boston 14, Mass.

AGENTS IN PRINCIPAL CITIES

IF IT'S BADGER-MADE IT'S GOT SOMETHING!

Badger

Packless Corrugated Expansion Joints



MAKE THOSE PLANS NOW FOR TOMORROW'S POWER PLANT

Power plant expansion and modernization programs which have been deferred because of wartime needs for Diesel engines should now be given consideration. Power users with completed plans will be among the first to get advantage of early deliveries. Nordberg Diesels have proved their dependable performance in war and will continue to do so in time of peace.

Let a Nordberg engineer survey your power problem. Engines can be furnished from 500 K. W. to 6000 K. W. in single units.

NORDBERG MFG. CO.
MILWAUKEE 7, WISCONSIN

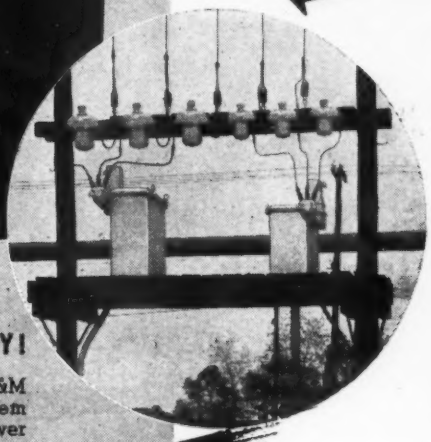
NORDBERG
DIESEL ENGINES

EC&M Builds 2300 Volt Motor Starters IN UNIT-FORM

FOR SAFETY . . .

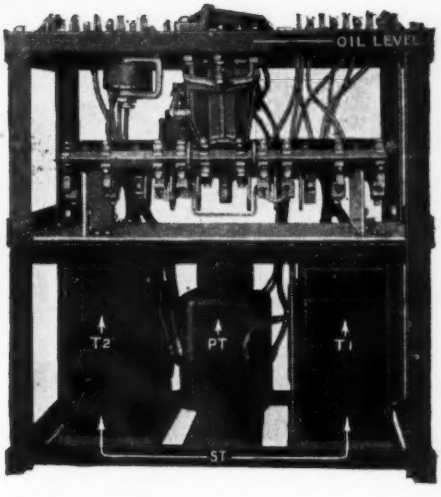
FOR CONVENIENCE IN INSTALLATION . . .

FOR LONG LIFE . . .



THEY COULDN'T RISK A DELAY!

Prominent oil refinery selected EC&M 2300 volt Starters and mounted them out-of-doors on platform between power poles.



Note clean-cut design of this reduced voltage starter mechanism for 2300 volt motors.

CLEAN-CUT DESIGN

1. Single, quick-break, double-throw contactor operated by a single magnet.
2. Two liberally-rated auto-transformers marked T1 and T2.
3. Potential transformer (marked PT) for 220 volt push button circuit.
4. Current limit relay trips mechanical latch to transfer from reduced to full voltage.
5. Variable reactor on top of mechanism permits quick change of transition-setting, when desired.
6. Continuous torque acceleration.
7. High torque efficiency in starting.
8. Adjustable, magnetic type overload relays, arranged for magnetic reset from push button.

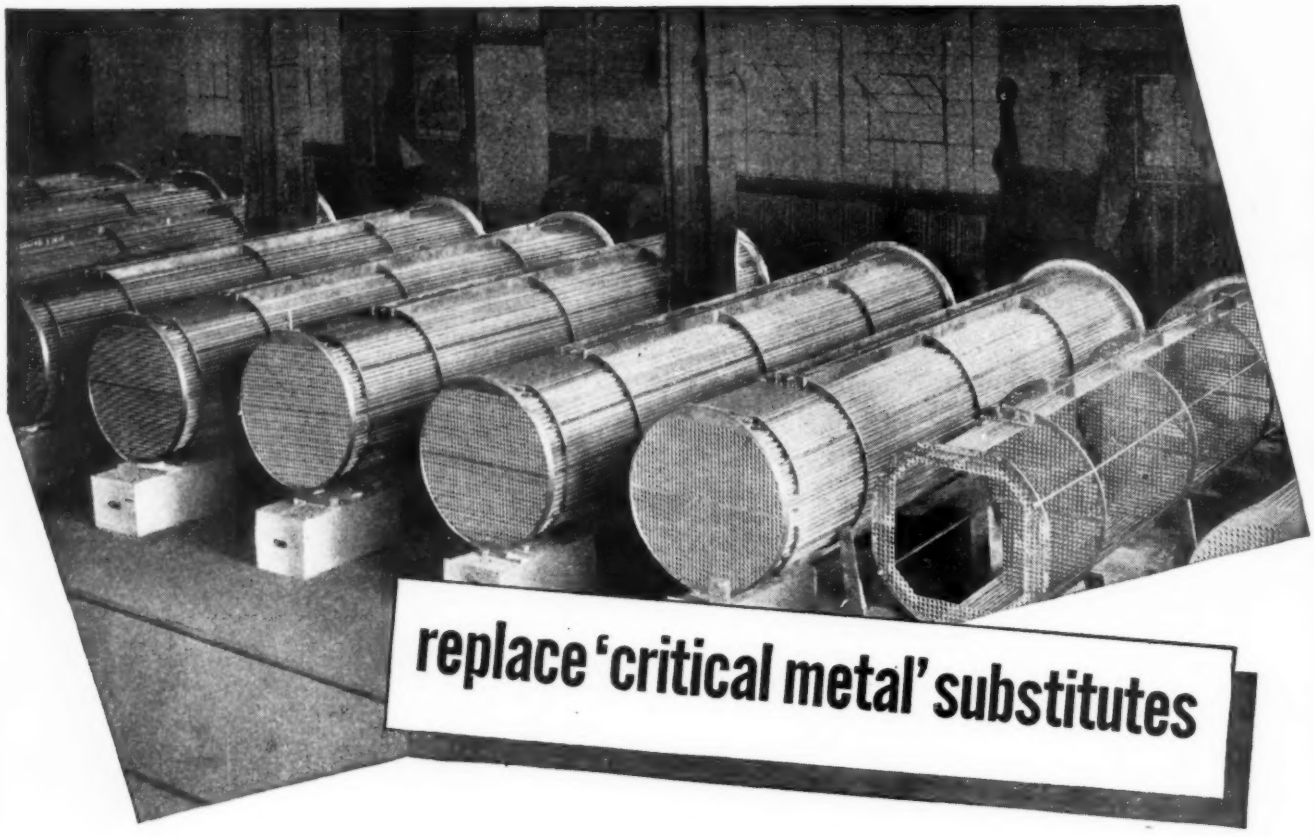
● In many plants, managements have come to know that EC&M Unit Starters are a valuable ally for their 2300 volt motor starting requirements. Complete enclosure of all high voltage parts not only provides a *shock-proof* installation but reduces time and material in installation. With the mechanism totally oil-immersed, operating parts are always lubricated and also protected from corrosion. Push button operation brings the motor up to speed with greater skill than human hands could do it. What could be safer—more reliable!

Ask for Bulletin 1047-C

THE ELECTRIC CONTROLLER & MFG. CO.

2698 E. 79th ST. ★ CLEVELAND 4, OHIO

"TUBE-UP" for full efficiency



Lummus heat exchangers — purchased for war emergency power plant and central station use during critical metal shortages — should now be reviewed for full heat transfer efficiency. In many instances tube bundles of substitute materials may now be replaced with bundles fabricated of metals that will increase operating performance. Furthermore, now is the opportune time to install additional heat exchangers which were necessarily omitted from plant design due to wartime restrictions.

Lummus engineering service is available for making such a review and for the study of specific metal replacement problems and the modernization of power plants to meet post war requirements. For further information write to:

LUMMUS POWER PLANT EQUIPMENT

SURFACE CONDENSERS
•
STEAM JET AIR EJECTORS
•
BLEEDER HEATERS
•
BOILER BLOWDOWN HEAT EXCHANGERS
•
EVAPORATORS
•
FUEL OIL HEATERS
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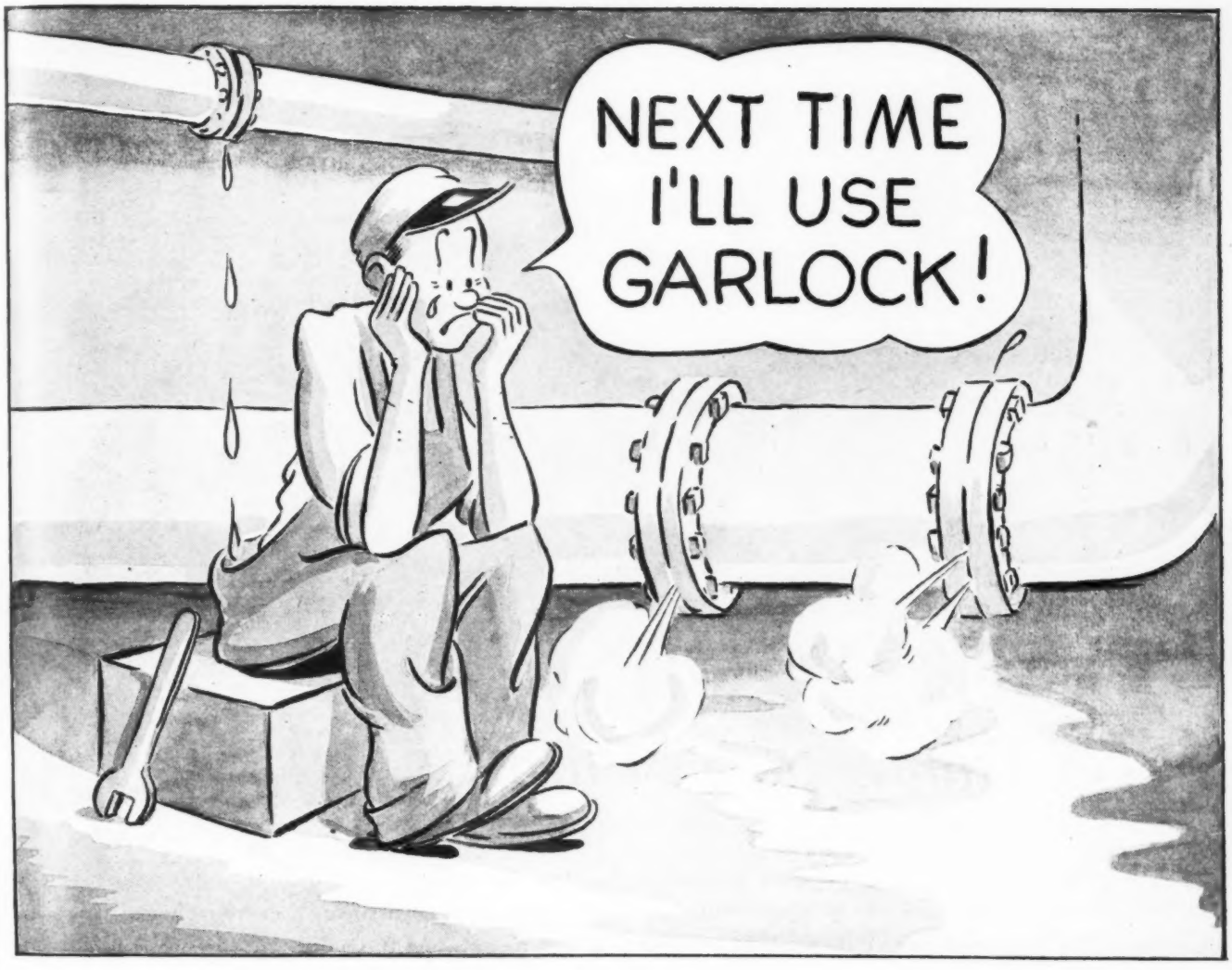
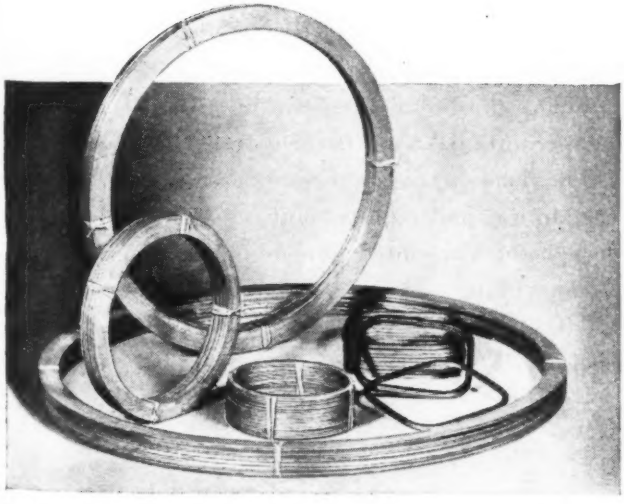
LUBRICATING OIL COOLERS

THE LUMMUS COMPANY, 420 LEXINGTON AVE., NEW YORK 17, N.Y.

LUMMUS

HEAT EXCHANGERS

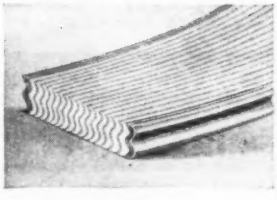




GARLOCK GUARDIAN GASKETS

are *Rugged, Resilient, Reliable* . . .

These semi-metallic gaskets are specially designed for joints subject to expansion and contraction with changing temperatures. The easy compression and instantaneous rebound also keep joints tight in equipment that vibrates.



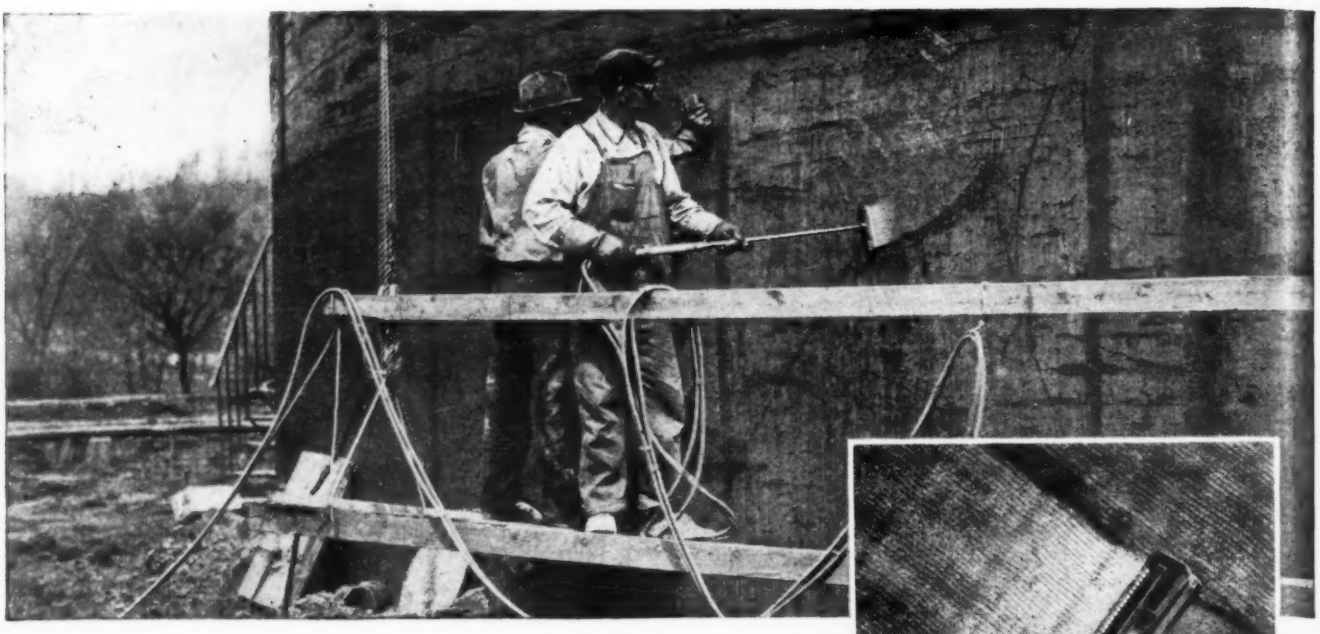
Standardize on GARLOCK for Dependability!

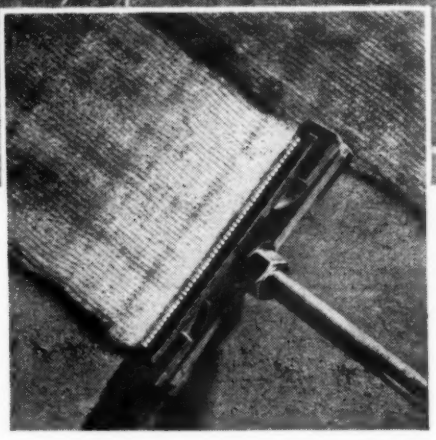
Pack up your troubles by using Garlock Packings, Gaskets and Oil Seals. They give *dependable* performance because they are produced in our own plant and are *quality-controlled* from raw material to finished product.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock





FLAME-PRIMING

Saves Time! Saves Paint!

Oxy-acetylene flame-priming of steel, to remove loose scale, rust, and moisture before painting, requires less time than former methods. When the oxy-acetylene flame sweeps over the steel, the intense heat causes scale to expand and pop loose, and thoroughly dries the surface. Loosened foreign material can then be swept free with a wire brush. The surface is then clean, dry, and warm—ready for painting even in cold, humid, or fouled atmospheres. Because flame-primed surfaces can be painted satisfactorily under these conditions, it is possible to schedule painting at night and under weather conditions ordinarily considered unfavorable. Paint applied to warm surfaces dries quickly, thus decreasing its permeability to moisture.

Since the steel is still warm from the oxy-acetylene flame when the paint is applied, the fluidity of the paint increases so that a better bond is obtained, and less paint is needed than for application on a cold surface. In addition, heat prolongs the life of the paint by giving it a low-temperature bake on the dehydrated surface.

The flame-priming process is easy to learn and easy to use, and requires only a small amount of equipment. For more complete information about flame-priming, get in touch with your nearest Linde representative. If you prefer, write for the booklet, "Flame-Priming," Form 5322A.

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD, UNIONMELT APPARATUS
OXWELD AND UNIONMELT SUPPLIES

The words "Linde," "Oxweld," "Prest-O-Lite," "Prest-O-Weld," "Purox," "Union," and "Unionmelt" are trade-marks of Union Carbide and Carbon Corporation or its Units.

"PRIMITIVE"

signifies

"without benefit of Steel"

ALL his life the Oriental peasant works ankle deep in water. If imagination stirs his primitive soul, he may dream of an easier way to water his rice paddy than by endlessly climbing the paddles of a wooden wheel to lift water from the canal.

He has never heard of anything so easy, so luxurious as the water systems that serve American farmers--built of steel pipe, steel pumps, steel tanks--which automatically bring plenty of clean, pure water for crops, livestock and all family needs.

Most of us can remember when even the American farmer's lot was little better than that of the Oriental peasant. That was before steel was plentiful--before manufacturers like Youngstown had devised efficient, economical methods to produce pipe, plates, sheets, bars, rods and wire for the fabrication of farm implements, tractors, trucks, automobiles, cribs, fencing, home equipment and the hundreds of other steel products that have freed the American farmer and his wife from much of their drudgery.

Without steel, America would revert to the primitive ways of our ancestors and of the world's "backward" countries. Fortunately, America has steel enough--steel to win the war now, and then to advance our civilization to new heights and guard it in lasting peace.

QUALITY — YOUNGSTOWN — SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

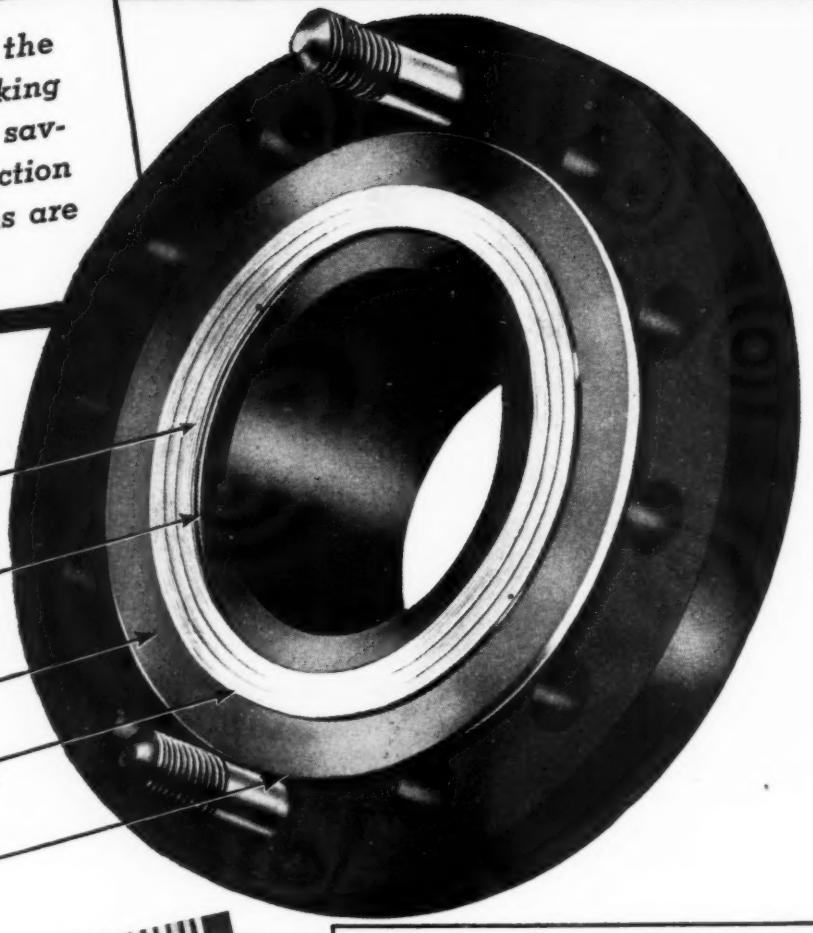
Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Electrolytic Tin Plate - Coke Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels.

FLEXITALLIC C-G GASKETS
for High-Pressure Flanged Joints

These gaskets have led the way in these war years making tight, lasting seals and in saving time for ship-construction and repair. The reasons are found in design features.



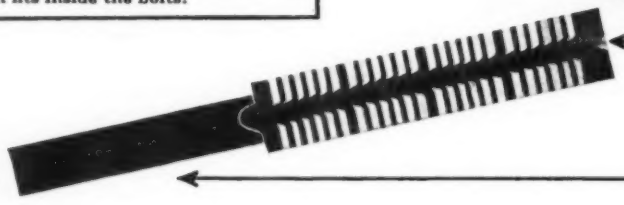
Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I. D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

Fit of surrounding ring, allows inner member to expand under compression.

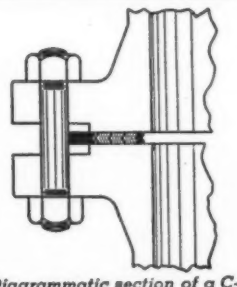
Correct position assured by O. D. of guage-ring which fits inside the bolts.



Construction of each spiral-wound member is governed by design of fittings and by the required bonding load for working pressure and temperature.

Gauge-ring saves installation time. Gasket is correctly installed when flanges are brought down to the ring in making up joint.

The combination of tight joints and time saving has been the cause of the wide use of Flexitallic C-G gaskets for marine service. The gasket is constructed for pipe lines that weave and twist with the ship, for lines that vibrate, that expand and contract with temperature changes. Choice of C-G's contemplates shake-down cruises without leaks, long service at sea with joints tight, sudden demands for full steam followed by full response because the joints hold. Choice of C-G's also contemplates ease of joint make-up, the saving of many precious man-hours in pipe fabrication and erection.



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

"Flexitallic" Reg. U.S. Pat. Office

Representatives in Principal Cities

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction

HERE'S WHAT ROCKBESTOS A.V.C. DOES UNDER SEVERE OPERATING CONDITIONS

RESISTS HEAT
" FLAME
" OIL
" GREASE
" FUMES
" MOISTURE
WON'T BAKE BRITTLE
" DE-CENTER
" BLOOM
" BURN
" ROT

Rockbestos A.V.C. Power Cable, at left, and similarly insulated Motor Lead Cable (National Electrical Code, Type AVA) has a maximum operating temperature rating of 110° C. (230° F.) and this permanently insulated construction:

1 A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

2 Outer felted asbestos wall, impregnated with heat, flame and moisture resistant compounds, serves as an effective barrier against high ambient temperatures and flame.

3 Lubricated varnished cambric for high dielectric strength and added moisture resistance, protected from heat, flame and oxidation between two felted asbestos walls.

4 Felted asbestos insulation, also impregnated with heat, flame and moisture resisting compounds, withstands conductor heating overloads and won't dry out, bake brittle or burn.

5 The conductor is perfectly and permanently centered in helically applied insulation.

One of 122 different wires and cables developed for severe operating conditions by Rockbestos.

Here's the wire you want for all those well-known trouble-spots such as soaking pits, forging presses, steam tunnels, lehrs, kilns and hot strip mills—because it's designed especially for operation under unusually severe conditions—with insulation that will stand up through years of trouble-free service.

Rockbestos A.V.C. has a *permanent* basic insulation of impregnated asbestos which will withstand temperatures up to 230° F. without baking or cracking. It is also resistant to flame, moisture, oil, grease and corrosive fumes and won't rot, bloom, flow, swell or de-center.

Decide now to eliminate expensive wire-failures and equipment shut-downs. You'll find a suitable wire for *every* hot-spot location among the 122 standard Rockbestos constructions. When ordering or inquiring, please furnish CMP allotment symbol and certification. For samples and complete information, write nearest district office or New Haven.

ROCKBESTOS A.V.C. 600 VOLT SWITCHBOARD WIRE
(National Electrical Code, Type AVB)

Sizes No. 18 to No. 4/0 AWG with varnished cambric and impregnated asbestos insulation and gray, black, white or colored flameproof braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A.V.C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heat-proof characteristics.

ROCKBESTOS 600 VOLT ALL-ASBESTOS RHEOSTAT
(National Electrical Code, Type A1)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.

ROCKBESTOS PRODUCTS CORPORATION
975 Nicoll St., New Haven 4, Conn.
NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.

ROCKBESTOS A.V.C.
THE WIRE WITH PERMANENT INSULATION

• BUY MORE WAR BONDS •

★ fuel conservation

FUEL SAVER
CALCULATOR
Fuel Savings at a glance with PF PIPE INSULATION
TONS COAL SAVED
per Fiberglas* PF Pipe Insulation Applied below
THICKNESS OF INSULATION

. . another job for FIBERGLAS*

Fuel shortages are anticipated again this winter. Once more the Government urges that every possible measure be taken to reduce waste and inefficiency in heating. And one sure, practical step toward the performance of this patriotic duty is through thorough and adequate insulation with Fiberglas Industrial Insulations.

In co-operation with the Government program to save critical fuel.

Yes, any part of any pipe or duct—any boiler, retort, heat exchanger or oven in your plant—that is "too hot to touch" is wasting war-essential fuel and costing you money. Just how much, it might surprise you to learn!

The significant fuel savings effected by Fiberglas Insulations can be seen at a glance on the Fuel Saver Calculator shown above. For example, 2-inch thick Fiberglas PF Pipe Insulation, on 100 feet of 4-inch pipe with a hot-face temperature of 400° F. in an 80° F. surrounding temperature, will save nearly 70 tons of coal a year. And just imagine the costly extra burden such heat losses also put upon air conditioning equipment!

This practical and useful vest-pocket device is yours for the asking. Write for your Calculator today, make a thorough inspection of your plant and add up the amount of fuel proper insulation could save. Then support the National Fuel Efficiency Program—and reduce your plant operating costs—by applying Fiberglas Industrial Insulations wherever there is a spot "too hot to touch".

Owens-Corning Fiberglas Corp., 2000 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

FIBERGLAS INDUSTRIAL INSULATIONS

1. PF Pipe Insulation—A lightweight, preformed pipe covering with high insulating efficiency for temperatures up to 600° F. Made in 3-ft. sections or segments for all standard pipe sizes. Fibrous ends of sections intermesh to form tight joints.

2. Blanket Type Pipe Insulation—With mesh wire on outer side to wrap around pipe and secure with wire through special edging. Manufactured in 2-ft. sections for pipes over 3" O.D. Will withstand temperatures up to 1000° F.

3. Metal Mesh Blankets—With mesh wire or expanded metal on one or both sides. Lightweight, and easily applied. 2 ft. x 4 ft. and 2 ft. x 8 ft. In standard thicknesses. Two types: For temperatures up to 600° F. and 1000° F.

4. No. 600 PF Block—Same materials as in PF Pipe Covering — in blocks 6" x 36" and 12" x 36", standard thicknesses.

5. OC-1800 High Temperature Block—A highly efficient and rugged molded block in sizes 3" x 18" and 6" x 36" and 12" x 36"—in standard thicknesses. Will withstand surface temperatures up to 1800° F.

6. Insulating Cement—For insulating fittings, valves and all irregular surfaces. Highly efficient . . . withstands temperatures up to 1200° Fahrenheit.

7. OC Mastic Finish—An asphalt emulsion cement for insulated pipe and equipment exposed to outdoor or high moisture conditions.

8. Insulating Wool, Type TW-F—Fabricated in bats, rolls and bulk. Used for drying-ovens, heaters, etc., for filling irregular spaces.

9. PF Insulation—Manufactured in 5 densities from 2½ to 9 lbs. per cu. ft.—standard sizes 24" x 48", 1" to 4" in thickness, according to density. For insulated panels, sound absorption and various semi-structural applications.

10. PF Roof Deck Insulation—9 lb. density with facing to facilitate mopping. Highly efficient, with incombustible, rotproof and moisture-resistant core, for application under industrial built-up roofings. Sizes 24" x 48". Thicknesses from $\frac{3}{16}$" to 2".

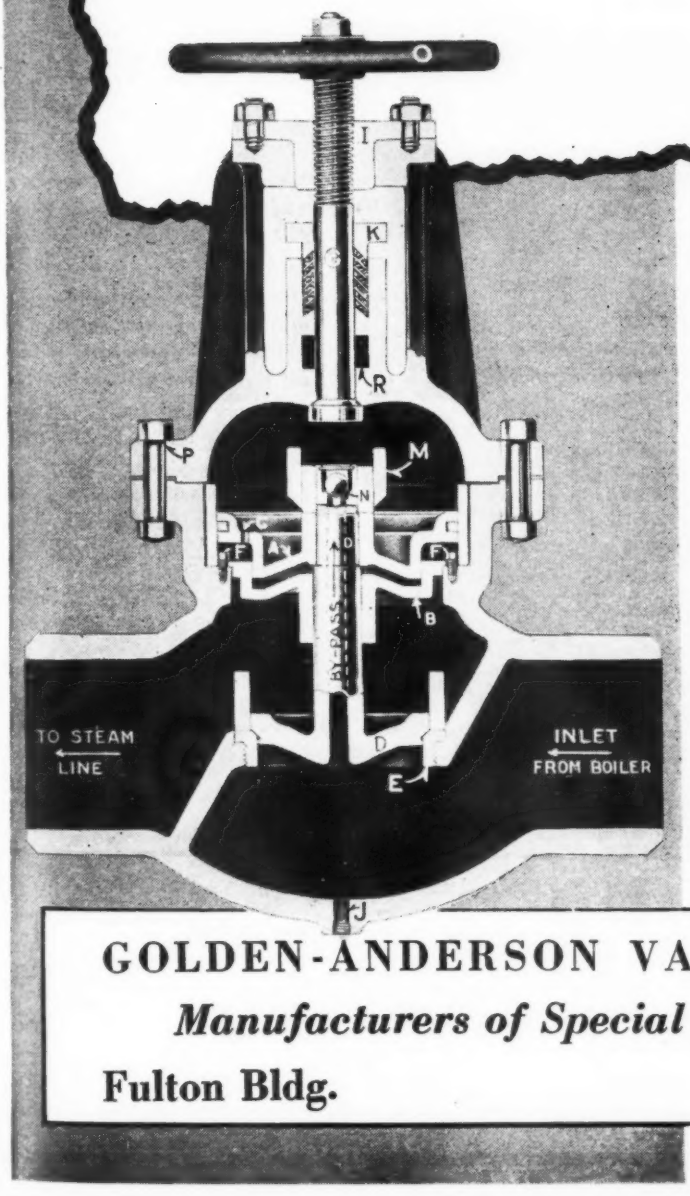
ARMY-NAVY

FIBERGLAS

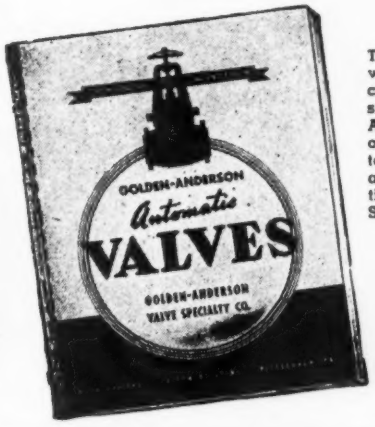
*Trade Mark Reg. U. S. Pat. Off.

INDUSTRIAL INSULATIONS

What would happen if a Tube blew in *your* Boiler Room...?



Plenty *could* happen—such as the whole battery exploding through the ruptured point . . . but nothing *can* happen if your boilers are equipped with these Triple-Acting Non-Return Valves! In the event of a blown tube or a pressure line break this valve will immediately cut off the flow of steam, isolating the boiler and preventing any possible damage.



This is only one of the wide variety of Specialty Valves regularly supplied by GOLDEN-ANDERSON. Write for our catalog. It contains complete, specific application and operation data on all G-A Specialty Valves.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

Manufacturers of Special Valves for Every Need

Fulton Bldg. Pittsburgh, Penna.

"A name worth remembering"

Fairbanks-Morse

To search constantly for ways to improve is a basic Fairbanks-Morse policy. Development work goes on continually in our research laboratories—in good years and bad, in time of peace and in time of war. During the months and years ahead this research will yield a rich harvest to users of industrial equipment.

R. W. Morse Jr.

General Sales Manager

Whatever your pumping requirements, you can specify *Fairbanks-Morse* Pumps and be *sure* of dependable service, efficient, low-cost operation, and long, trouble-free life. The Fairbanks-Morse line includes all types in a full range of capacities—centrifugal, split-case centrifugal, built-together, angle-flow, power, rotary, turbine, propeller, paper stock, sewage, trash, and many other types.

Diesel Locomotives • Diesel Engines • Generators
Motors • Pumps • Scales • Magnetos
Stokers • Railroad Motor Cars and Standpipes
Farm Equipment

BUY MORE WAR BONDS

Pumps

Fairbanks, Morse & Co.
Chicago 5, Illinois

© 1944, Fairbanks, Morse & Co.

LIQUID LEVEL TARGET *for* EYES

OUTSTANDING FEATURES

Eye Level Readings of boiler water or other liquid levels on instrument panel or other convenient location.

•

Instant, Accurate Indication —a positive check on remote, hard-to-see liquid level gages.

•

Operated by the boiler water —itself. "Positive as the law of gravity."

•

No stuffing boxes. Frictionless Mechanism — Jewelled Bearings.

•

Indicating mechanism never under pressure. Magnetic transmission between actuating and indicating mechanism.

•

Indicates in full or reduced scale. Up to 8 ft. level variation.

•

Compact—Moderately Priced. Available for all pressures up to 1500 lb.

•

Easily Installed on new or existing equipment.

Now, stop squinting and guessing at boiler water levels. End the risk of serious damage to important equipment. Keep accurate check on other liquid levels in your plant.

With the Yarway Remote Liquid Level Indicator—"the Eyes have it" all the time, right in front of them—on instrument panel or wall, wherever it's most convenient and prominent. Quick, accurate, eye-level readings regardless of location of the levels to be checked.

Hundreds in Use

Read the features listed at the left. Facts that have already influenced the purchase of hundreds of Yarway Instruments for utilities, industrial plants, institutions and marine service.

And everywhere, use has multiplied satisfaction with this positive, accurate, dependable, *popularly-priced instrument.*

A Development of the Yarway Steam Laboratory

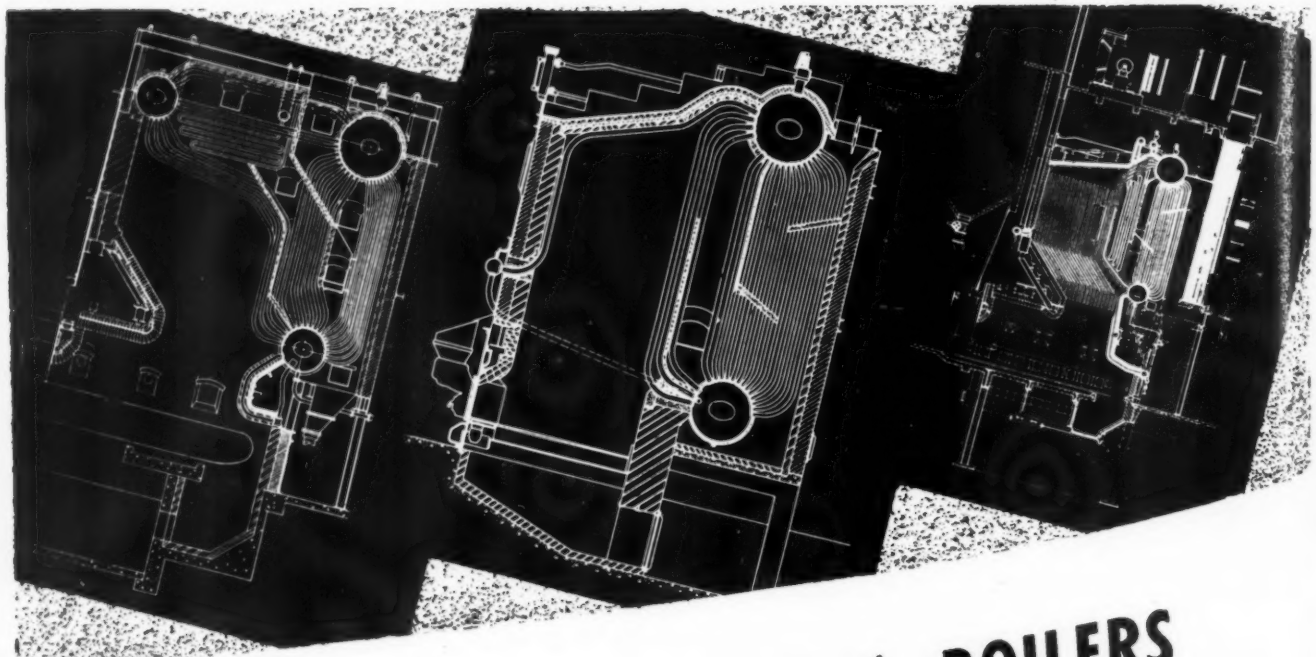
The Yarway Remote Liquid Level Indicator is another development of the unique Yarway Steam Laboratory, responsible for all new Yarway products and improvements. Here, a device must be right or it never meets the public. For instance, for the past three years, an accelerated endurance test has been carried out on a standard stock Yarway Indicator. In continuous operation, day and night, under rapidly-changing liquid levels that produced full pointer travel, the mechanism has operated through 17 million complete travel cycles —equivalent to 50 years of ordinary boiler room service, with no repairs, replacements of parts or change in calibration.

Why not get this positive, dependable, convenient indication of the liquid levels in your plant?

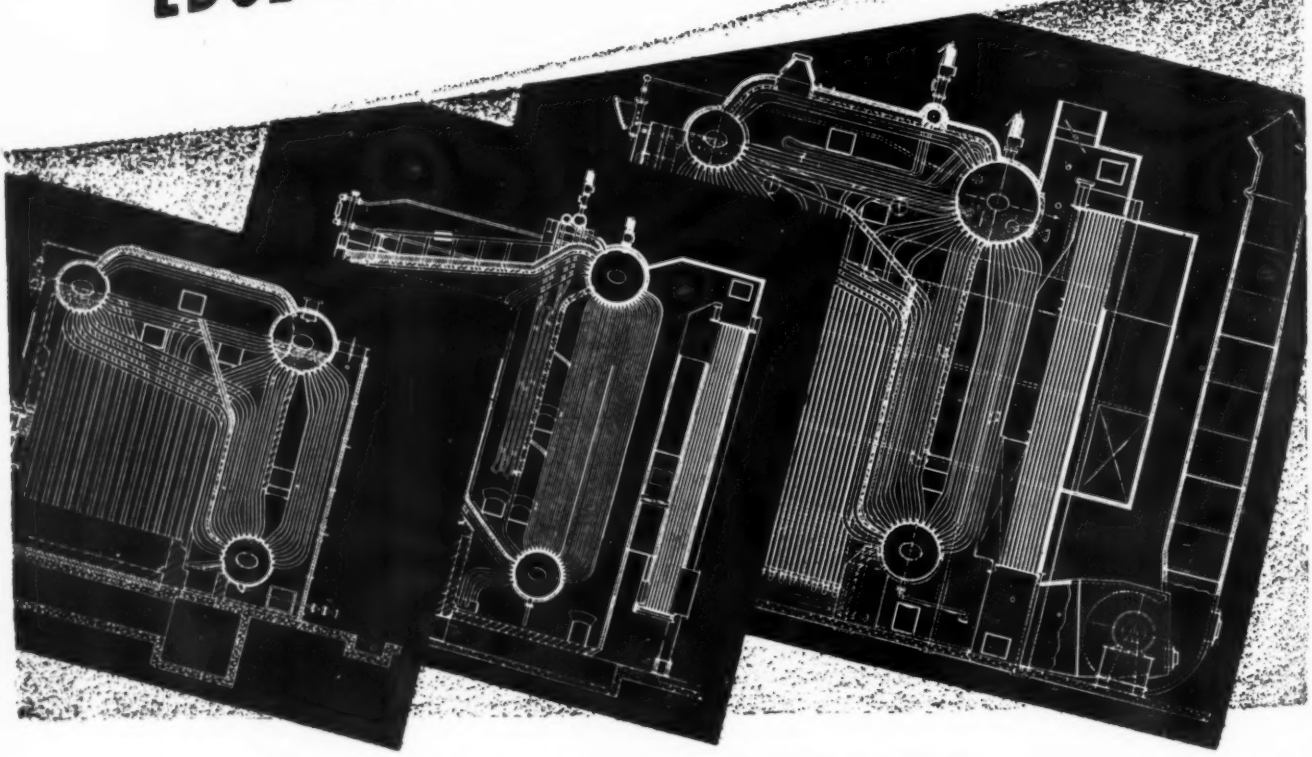
For further information, write for Bulletin WG-1820.

YARNALL-WARING COMPANY · 100 Mermaid Ave., Phila. 18, Pa.

YARWAY REMOTE LIQUID LEVEL INDICATOR



EDGE MOOR *Water Tube* BOILERS



All designs of steam generators for any required capacity and up to 900 lbs. drum pressure are completely engineered and built at Edge Moor.

The combination of Edge Moor engineering and manufacturing control insures the ultimate in modern power plant construction.

STEAM GENERATING EQUIPMENT

EDGE MOOR
IRON WORKS, INC.

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE: EDGE MOOR, DELAWARE

a NEW *Industrial* POWER TUBE *by* Federal

Federal presents a new and rugged power tube that fills an immediate demand — a power tube that has been *specially* designed for industrial use in high-frequency heating equipment, both dielectric and induction.

Really built to withstand the constant jars, shocks, and vibration commonly encountered in manufacturing operations, this heavy-duty vacuum tube is very conservatively rated, and will stand up under extremely hard usage.

Widely spaced, unusually sturdy filament and grid elements, without internal ceramic insulation, give this tube a ruggedness that makes it the logical choice for dependability in the design of industrial heating equipment.

For industrial power tubes, and also for rectifier and transmitting tubes, see Federal first... because "Federal always *has* made better tubes."

TECHNICAL DATA FOR TYPE F-5303

Filament Voltage	11.0 volts
Filament Current	27.5 amps.
Maximum Ratings for Maximum Frequency of 50 Mcs.	
DC Plate Voltage	3500. volts
DC Plate Current	1.0 amp.
Plate Dissipation	1200 watts
Overall Height	app. 7"
Maximum Diameter	3½"

Supplied with 6" flexible copper leads, 2 on each terminal.

Type of Cooling . . . . . Forced-air
(Also supplied for water-cooling, type F-5302.)

FEDERAL TELEPHONE & RADIO — FTR

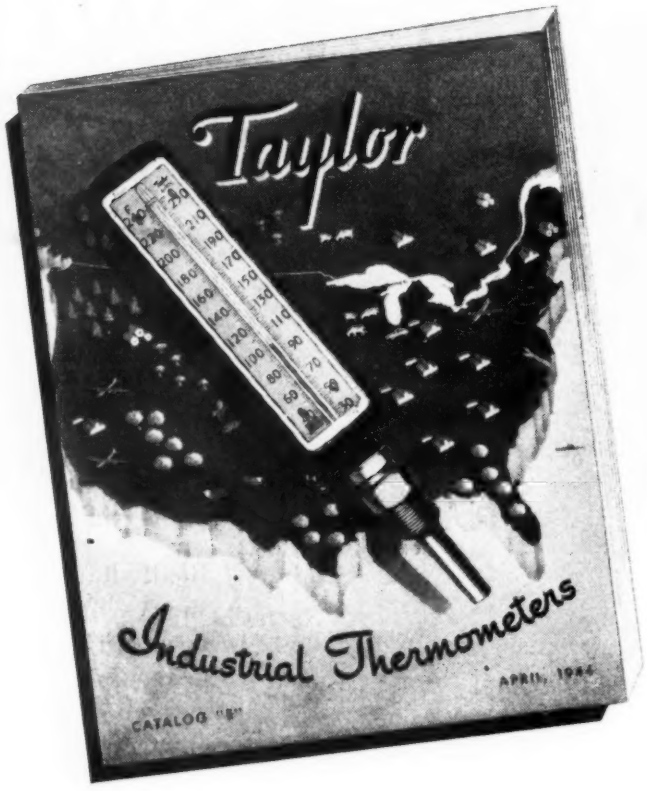
Federal Telephone and Radio Corporation

An IT&T Associate

Newark 1, New Jersey

IN HOME AND INDUSTRY

Send for Taylor's Industrial Thermometer Book



HERE it is! Taylor's new catalog showing a complete selection of Taylor Mercury-in-glass Industrial Thermometers for practically every power plant application, including steam distribution systems, within the temperature limits of −40° and +950°F. or equivalent Centigrade.

Available in a wide variety of standard temperature ranges within the above limits, with a variety of bulb constructions to fit individual applications.

You can read a Taylor Industrial Thermometer at a glance. Taylor's BINOC TUBING—with its wide angle of vision and high magnification actually *invites* frequent readings. To further improve ease of reading and facilitate installation, they are supplied in straight, 90° angle, right or left side and oblique angles. They're a product of 94 years of Taylor Accuracy. Write for your free booklet today! Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

ARMY ★ NAVY

Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS

SHOP FABRICATION

of Piping Assures Accurate Control of Welding Procedure

Joining 14" carbon-molybdenum corrugated tangent to plain bend . . weld areas electrically pre-heated . . . welds stress relieved . . . note temperature control instruments.

Welding flanges on 8" stainless returns.

WELDING plays a major part in shop-fabrication of piping. This is particularly true where alloy steels for high temperature, high pressure piping or stainless steels are involved.

Welders must be carefully trained, thoroughly experienced in qualified welding procedures, and pass operators qualification tests before being entrusted with this highly specialized type of work.

At Pittsburgh Piping & Equipment Company, control of welding procedure also includes periodic tests of welders work, test samples being analyzed and inspected in our Metallurgical laboratory.

This carefully systemized procedure is indicative of the care that is exercised in every phase of shop-fabrication of piping, which includes such operations as bending, flanging, Van Stoning, machining, heat treating, stress relieving, pressure testing, inspection, and checking for dimensional accuracy.

That's why shop-fabrication assures an infinitely better piping job, whether it involves a single unit or a complete piping system. Our engineers will gladly work with you on any piping problem confronting you. Contact our nearest representative or write us direct.

DO MORE THAN BEFORE—BUY EXTRA WAR BONDS

Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

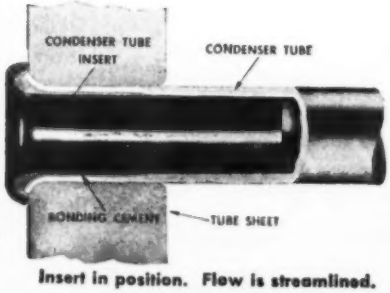
Woolworth Building, New York
Occidental Building, Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston
634 S. Gramercy Place, Los Angeles

Make CONDENSER TUBES *Last Longer!*

Install JOHN CRANE
CONDENSER TUBE INSERTS

Unprotected condenser tubes most often fail at the inlet end; the section most vulnerable to pitting and thinning. The John Crane Condenser Tube Insert *armors* the belled mouth and entrance section of the tube—*completely eliminates inlet end air erosion and sand abrasion;* helps to prevent outages.

These Inserts are molded of a *hard, wear-resistant* bakelite material, unaffected by temperatures to 275° F. and resistant to contaminated salt or fresh water. Installation is easy on old or new tubes: simply slip the Insert into place. Available for 5/8" and 3/4" 16 gauge, or 5/8", 3/4", 7/8" and 1" 18 gauge tubes.

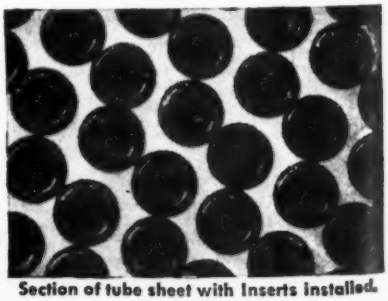


Insert in position. Flow is streamlined.

Service tests over a long period of time show that John Crane Condenser Tube Inserts

- **Greatly lengthen tube life**
- **Save critical metals**
- **Pay for themselves many times**

Send for illustrated bulletin, or consult our branch office nearest you for full information.



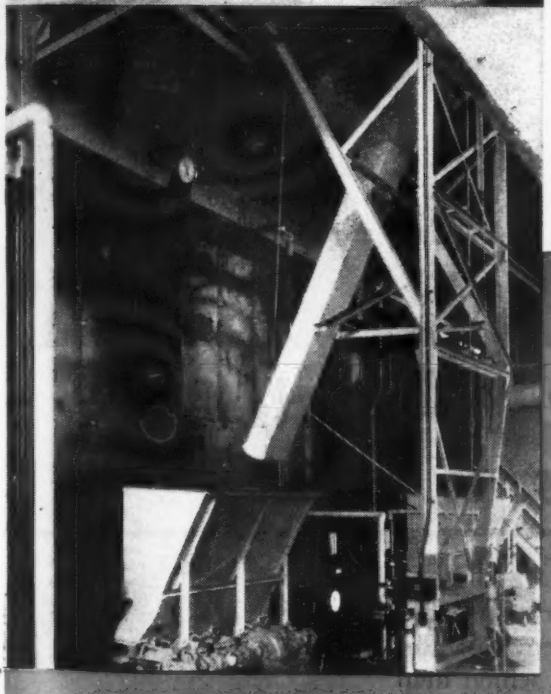
Section of tube sheet with Inserts installed.

CRANE PACKING COMPANY
1811 CUYLER AVE. • CHICAGO 13, ILL.

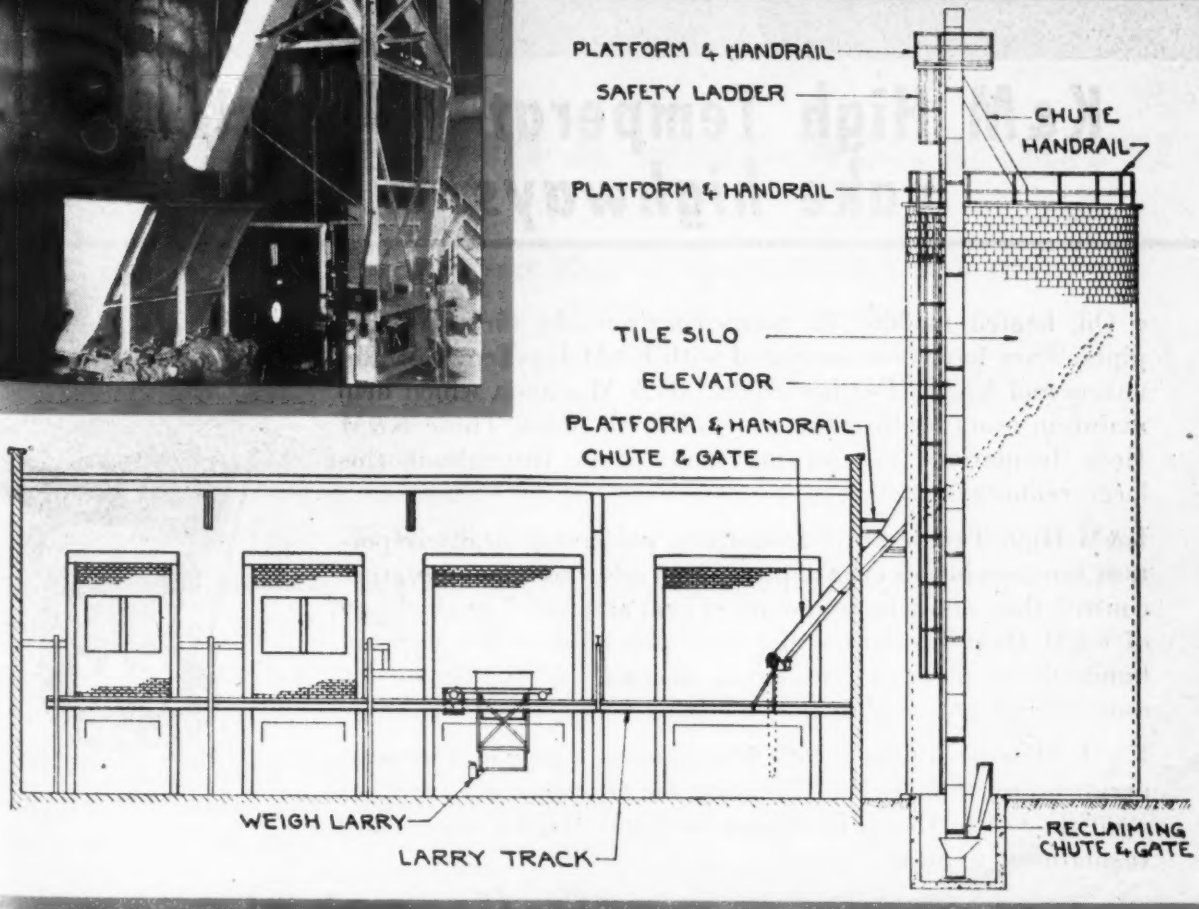
BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

CRANE PACKING CO., LTD., Hamilton, Ontario, Canada
Branches: Montreal, Toronto, Vancouver

FAIRFIELD
Coal and Ash Handling... SYSTEMS



• The Fairfield Silo Storage System is an efficient and economical method of storing and reclaiming coal. It is particularly adapted to plants requiring 200 to 1000 tons coal storage . . . The silos are built of vitrified tile—require little ground space—are located outside the boiler house—require no changes to present structure—provide insulation against freezing . . . In operation the coal is automatically handled from car to storage to stoker or pulverizer . . . Fairfield engineers, builds and erects the entire system—you have but one responsibility for the entire installation . . . consult a Fairfield Engineer on your coal and ash handling requirements.



THE FAIRFIELD ENGINEERING CO.- MARION, OHIO

BUILDERS OF COAL AND ASH HANDLING EQUIPMENT

K&M High Temperature Insulations make *highways for heat*

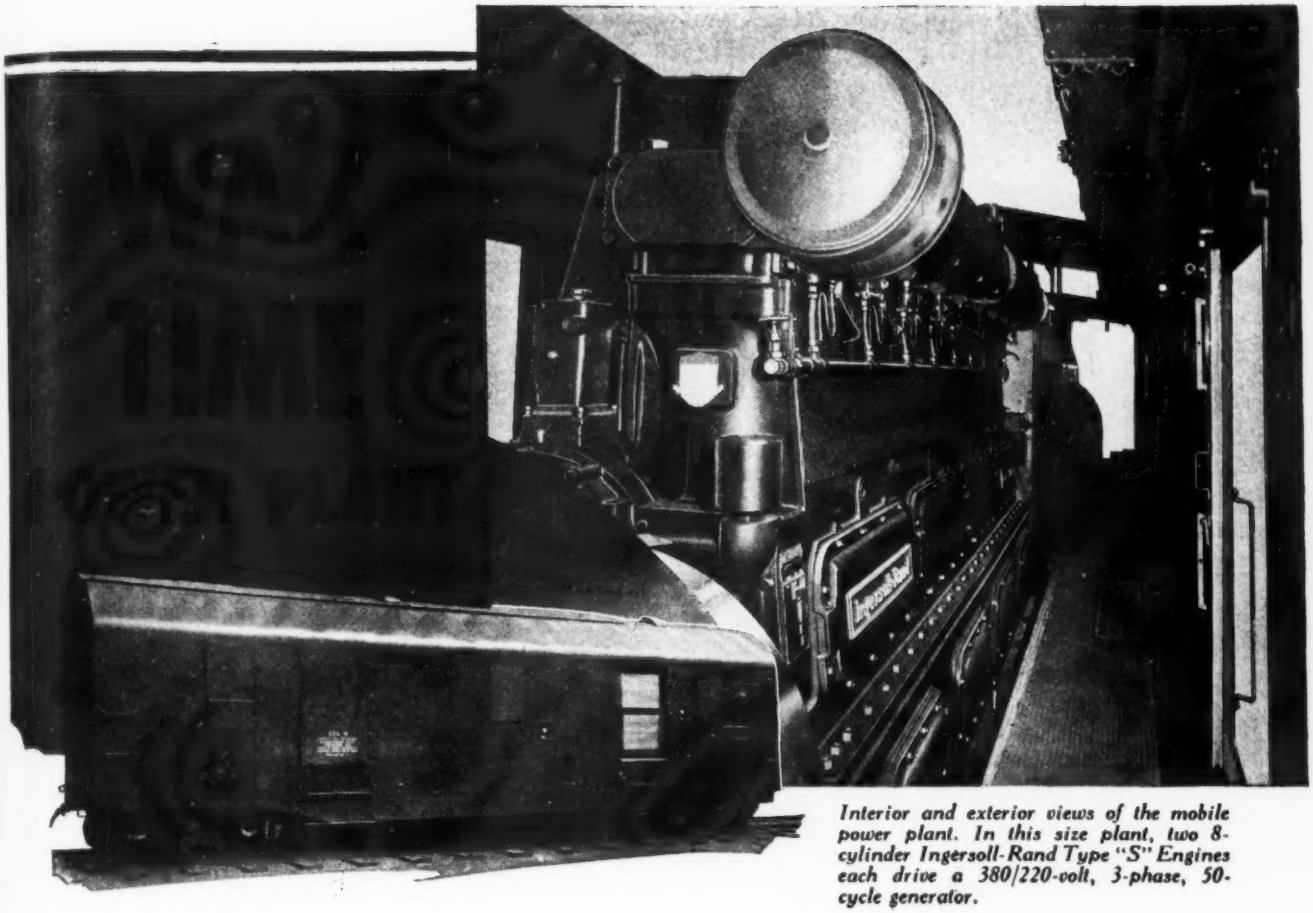
• Oil, heated to 800° F., pours continuously through these pipes. They have been insulated with K&M Hy-Temp Combination and K&M "Featherweight" 85% Magnesia which help maintain exact temperature control at all times. These K&M Heat Insulations are serving many lines throughout this large refinery.

K&M High Temperature Insulations perform a vitally important function in this type of process. In addition to temperature control, they save a huge amount of heat and fuel. The efficiency of K&M Heat Insulations has been proved over the years in hundreds of plants in numerous branches of industry . . . especially in power plants.

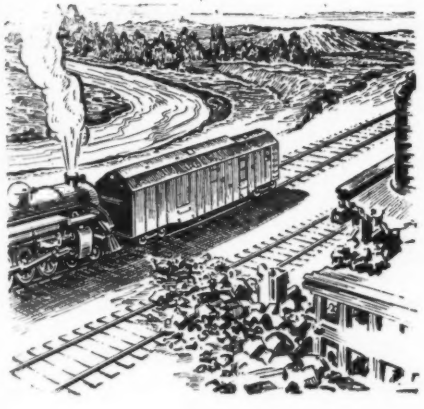
K&M "Featherweight" 85% Magnesia is designed for temperatures up to 600° F.—Hy-Temp for temperatures reaching 1900° F. For further information on K&M High Temperature Insulations, write us.

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA



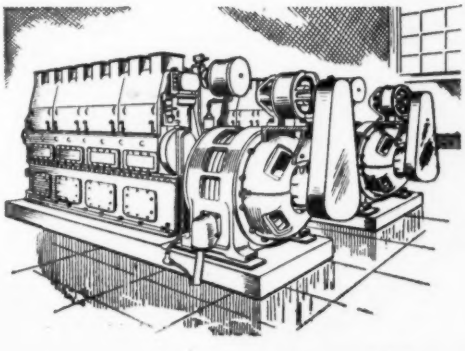
Interior and exterior views of the mobile power plant. In this size plant, two 8-cylinder Ingersoll-Rand Type "S" Engines each drive a 380/220-volt, 3-phase, 50-cycle generator.



WITH A POST-WAR UTILITY!

The people of the Soviet Union know from bitter experience what the destruction of electric power facilities means. To eliminate delays of many months before essential permanent electric service can be restored to re-occupied areas, the Soviet Union is using a number of railroad mobile power plants which can be sent quickly to any place where power is needed.

Ingersoll-Rand Type "S" Diesel Engines drive the generators for many of these units. We are pleased that our engines were selected, because we know that reliability was a primary consideration in the choice of all equipment. Gratifying, too, is the knowledge that these engine-generator sets will long outlive their first assignment. As stationary power plants, they can provide economical, dependable electric power for many years to come.

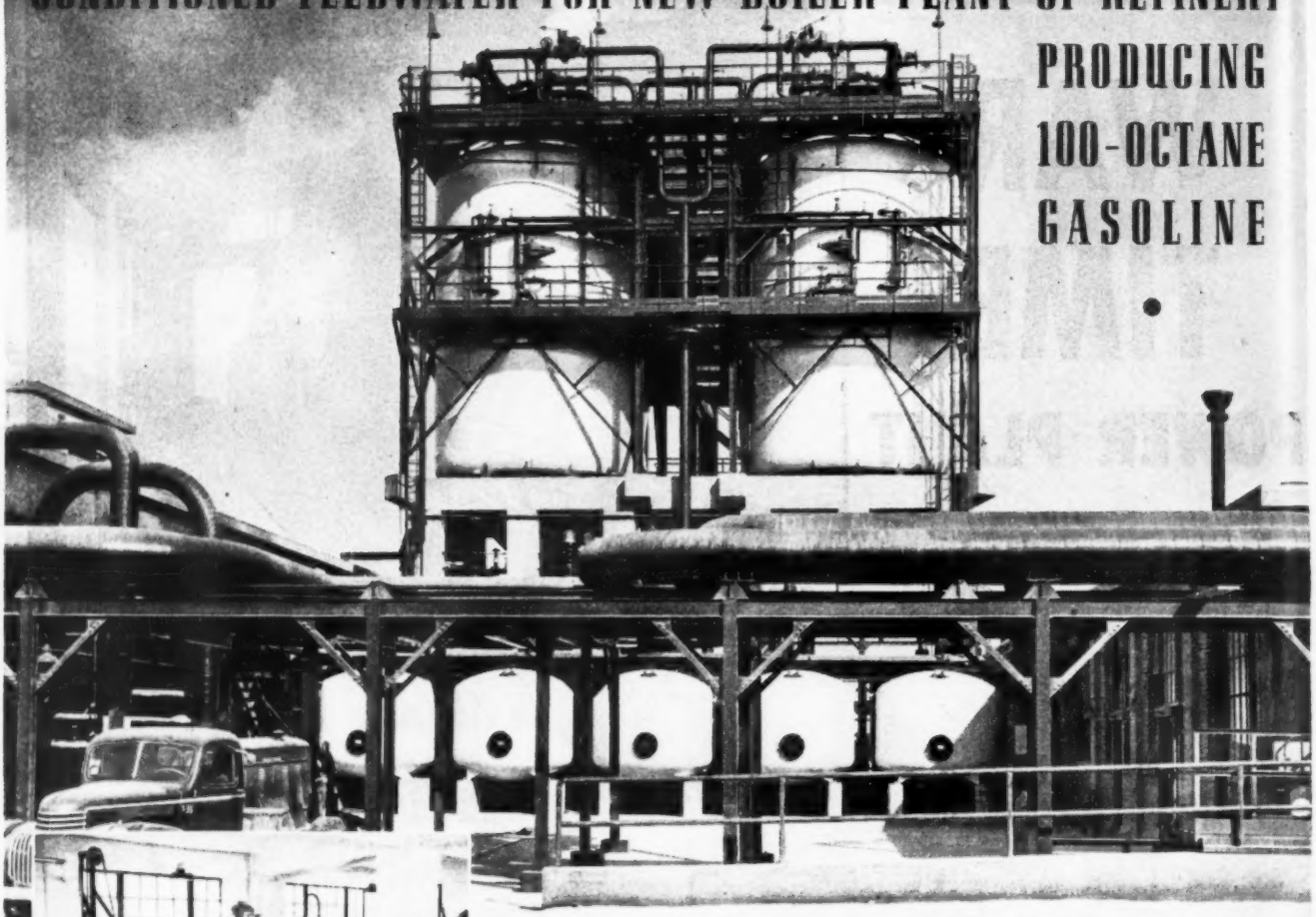


Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

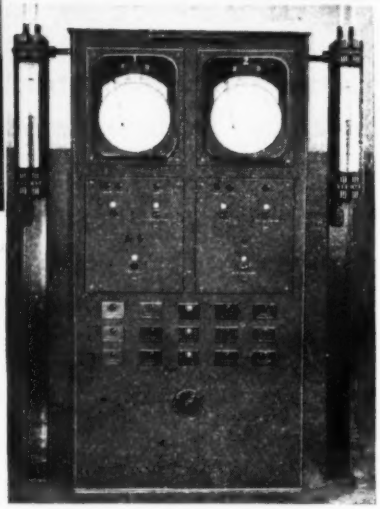
7-548

CONDITIONED FEEDWATER FOR NEW BOILER PLANT OF REFINERY PRODUCING 100-OCTANE GASOLINE



Sedimentation Tanks of the two Softeners and five of the ten Filters.

Above—Chemical Mixing Tank.



Right — Cochrane Flow Meter Panel Board for Automatic Control of Acid Feed.

AT one of the big California refineries now devoted to the production of 100-octane gasoline exclusively, the installation illustrated here, consisting of two 50,000 GPH, Cochrane Deaerating Hot Process Softeners, with ten 9′ dia. Filters, Mixing Tank, etc., supplies conditioned feedwater to the new high-pressure boilers. Many unique Cochrane features distinguish this installation, among which are a stirring mechanism which reduces turbidity to less than 5 ppm, automatic sludge blow-off, backwashing of filters with filtered water and panel board control of chemical feeds. • Write for complete details of this job or for a copy of Publication 3000, "Hot Process Softeners."

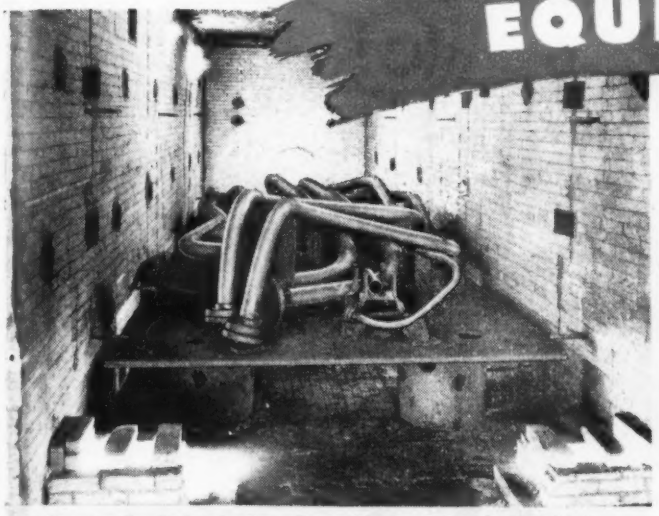
COCHRANE CORPORATION • 3106 N. 17TH STREET • PHILADELPHIA 32, PENNA.

COCHRANE

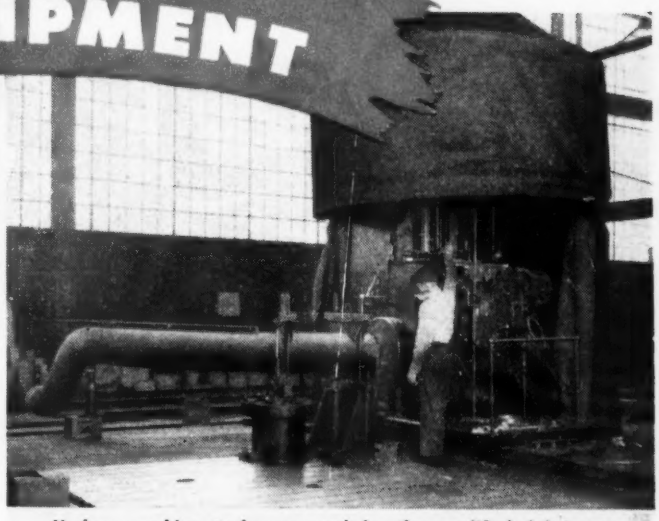
SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

Modern Pressure Piping Requires

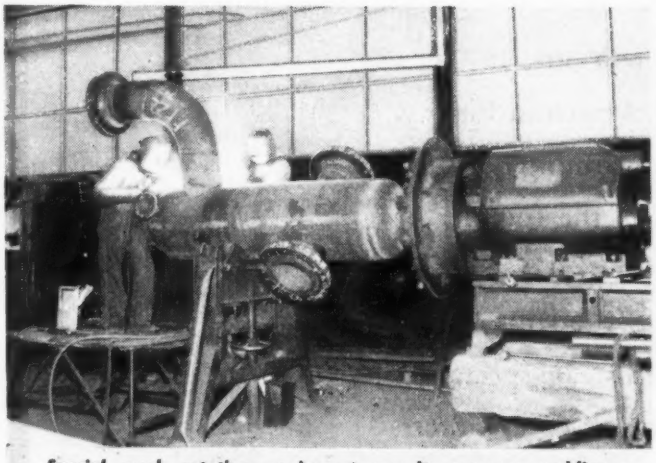
MODERN SHOP EQUIPMENT



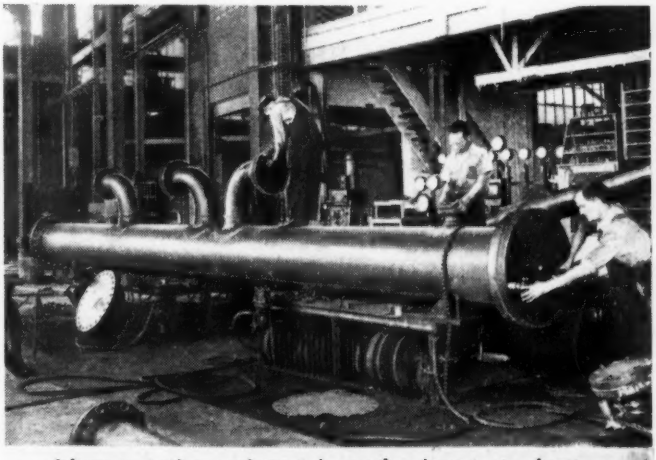
Furnace for heat treating alloy piping and for stress relieving shop-welded subassemblies.



Modern machine tools are used by the qualified fabricator for the accurate facing of pre-fabricated piping.



Special work rotating equipment permits pressure welding under the most favorable conditions.



Adequate testing equipment is another important advantage of the qualified pipe fabricator.

Knowing that "the workman is no better than his tools," qualified pipe fabricators have equipped their plants with many facilities that are not usually available in the field, but that are essential to the proper fabrication of modern pressure piping. Included are layout tables, bending equipment, form cutting machines, rotating fixtures and jigs for welding, special machine tools, preheating and stress relieving equipment, straightening tables, special testing equipment, etc. These facilities represent an enormous investment and are necessary to assure the high quality, speed, economy and easy installation of pre-fabricated pressure piping.

Pre-fabricated piping is delivered to the job as a series of subassemblies with all difficult operations performed. These subassemblies are commercially practical, heat treated and stress relieved when necessary, shop tested, accurately aligned, thoroughly cleaned and inspected. Erection requires a minimum of time and labor . . . the finished job is better piping.

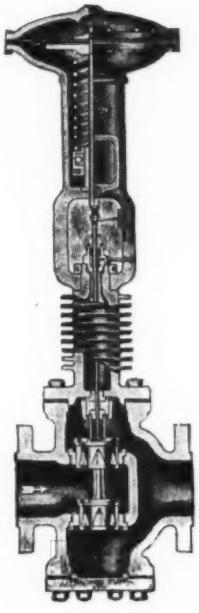
THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

P.F.I. THE PIPE FABRICATION INSTITUTE G-1

1108 CLARK BUILDING • PITTSBURGH, PA.

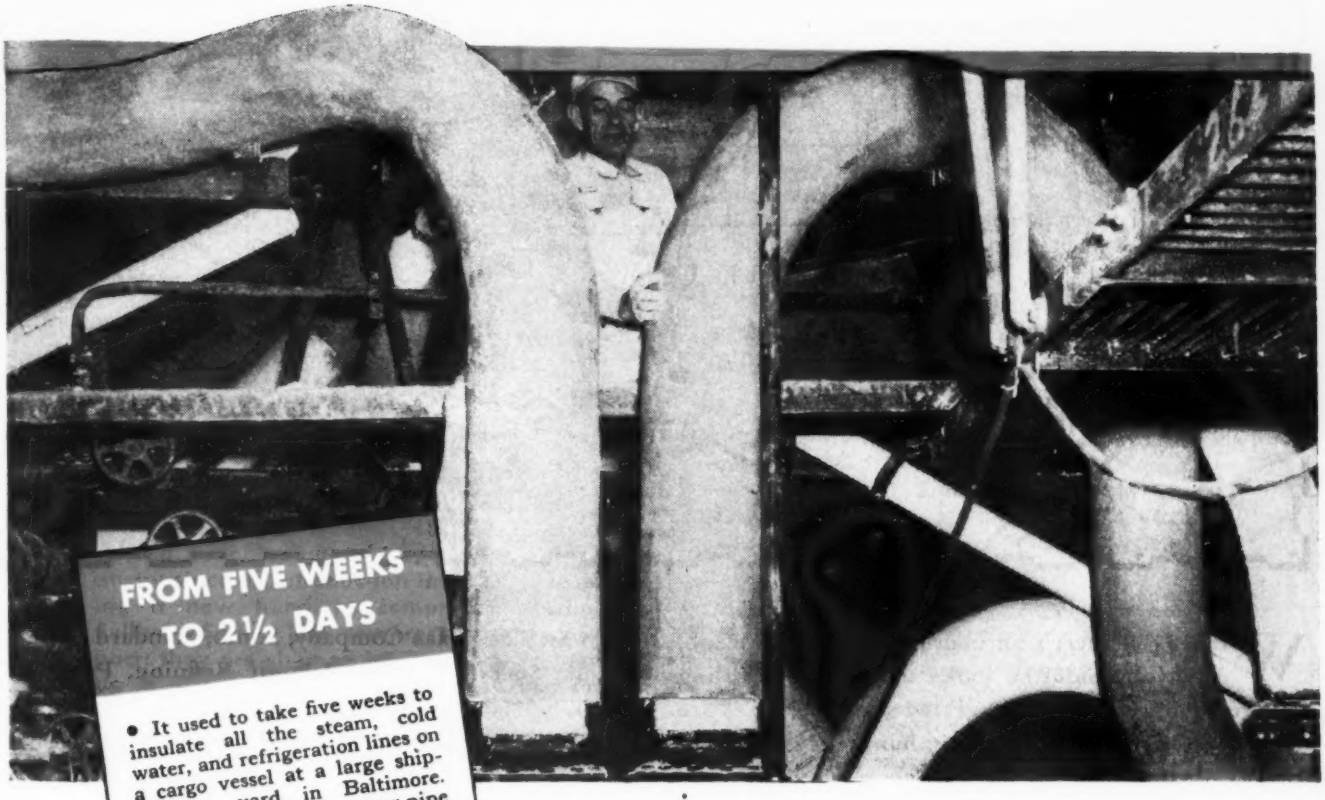
IT BEGAN the day after New Years, 1879 . . . one of the worst storms in American history. It was a cold winter—but there was warming news for steam plant operators that year when the founder of this company introduced the world's *first* steam trap. For 66 years since then, Tim Kieley and his family have continued to pioneer and perfect steam specialties and pressure flow controls. Speaking of cold winters, here's a K & M Diaphragm Motor Valve for any extremes of temperature, very low or very high. This precision device, with its finned bonnet, gives control of steam, liquids, gases or air within 1% of initial pressure. Write for Catalog No. 66, which gives full descriptions, specifications and capacities of this dependable Kieley & Mueller No. 488 Valve.



KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879
2001-43rd ST., NORTH BERGEN, N. J.

You get a better job - faster - with

ARMSTRONG'S CONTRACT SERVICE FOR HEAT INSULATION



FROM FIVE WEEKS TO 2½ DAYS

• It used to take five weeks to insulate all the steam, cold water, and refrigeration lines on a cargo vessel at a large shipbuilding yard in Baltimore. Done by skilled Armstrong pipe coverers, the time was reduced to only 2½ days. In one month, for instance, 13 such ships were completely insulated.

Hot lines and cramped quarters did not slow the 60 to 100 experienced mechanics, supplied by Armstrong's Contract Service, in this important work.

That's typical of the speedy, money-saving performance that is available to YOU through Armstrong offices in most of the nation's industrial areas.

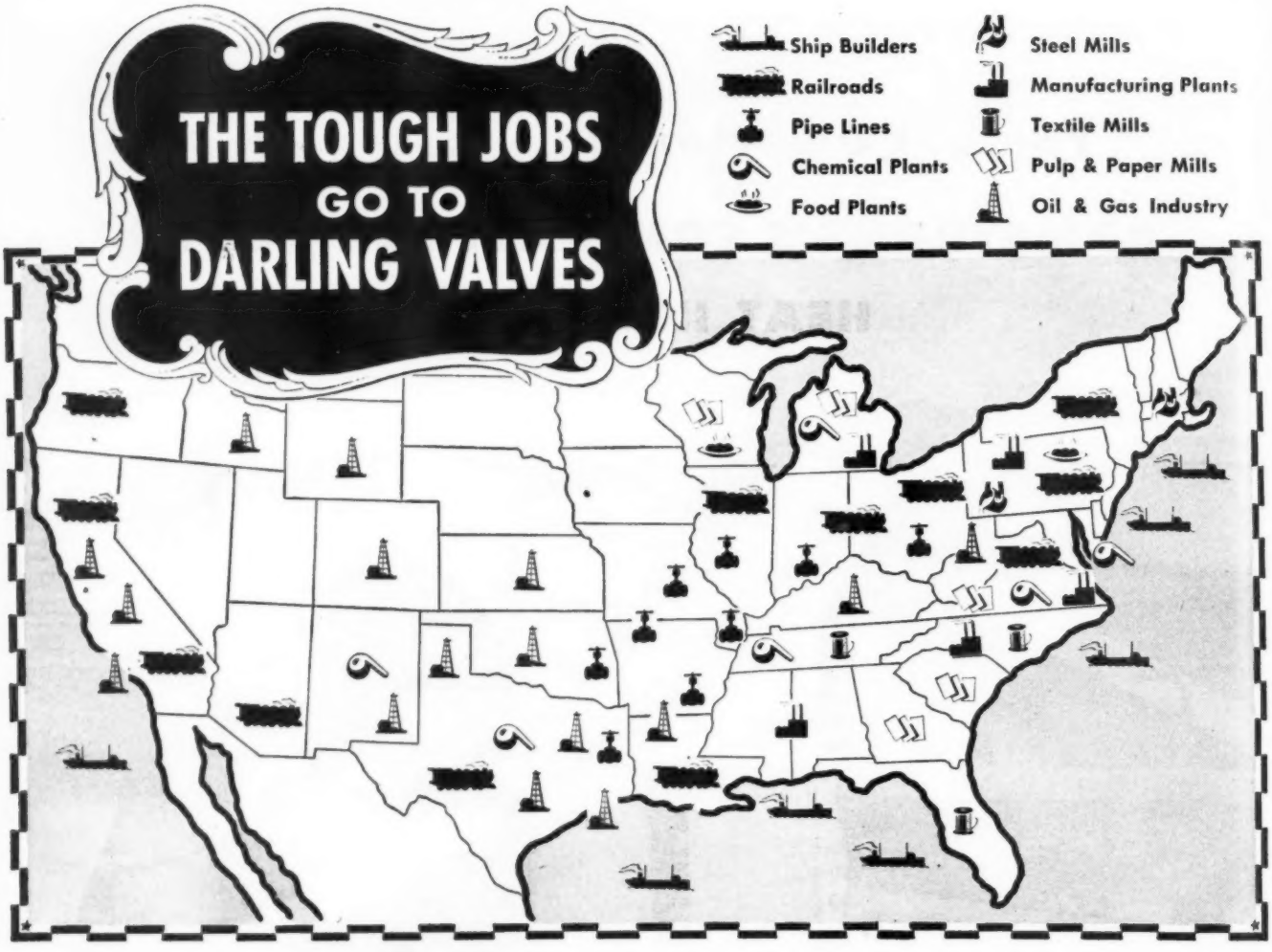
CAREFUL PLANNING that speeds the work is only one of the advantages you enjoy when you use Armstrong's complete heat insulation contract service. You get also the benefit of Armstrong's long engineering experience, materials of tested efficiency, and trained, experienced workmanship in application. The Armstrong organization takes full responsibility for the planning, supervision, materials, and workmanship of the entire job.

When you get Armstrong on your heat insulation job, you can be sure of satisfaction. For complete details write today to Armstrong Cork Company, Building Materials Division, 7001 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG CORK COMPANY

Complete Insulation Ⓐ Contract Service for All Temperatures, from 300° below zero to 2600°F.

THE TOUGH JOBS GO TO DARLING VALVES



WHEREVER there's an unusually tough valve job, American industry looks to Darling. Darling fully revolving double disc parallel seat gate valves are first choice for the tough jobs in hundreds of big and little companies.

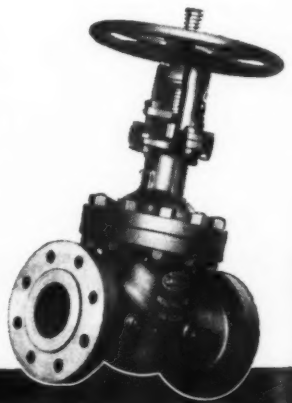
Here are a few of the well known companies using them. We will gladly tell you the names of other Darling users if you want to check their experience.

In the chemical industry users include Du Pont, Dowell, Dow Chemical, American Cyanamid & Chemical Corp., Atlas Power, Chemical Process Co., Hercules Powder, Carbide and Carbon Chemicals Corp., Solvay Process Co., and scores of others.

In the oil industry practically every big producer, refiner, or distributor uses Darling valves, companies such as: The Texas Company, Sohio, Standard of California, Socony-Vacuum, Atlantic Refining, Pure Oil, Shell, Sinclair, Skelly, Cities Service, Gulf, etc. It is significant of the excellence of these valves that they were chosen for the "Big Inch" pipe lines.

Other fields in which Darling valves are long established are natural gas, railroad, textile, paper, steel, ship-building, glass, and general manufacturing industries.

So when you install Darling valves, you are getting valves that have proved their dependability in billions of hours of the toughest kinds of service.



If you have a tough valve job—if you use iron, bronze, cast steel, forged steel and corrosion-resistant gate valves, we will be glad to send you our Catalog No. 17 and discuss your problems. Your inquiry will receive our prompt, careful attention.

TRADE DARLING MARK

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

...which house would you buy?

THERE is little similarity between the huge, rambling house of the 1880's and today's compact, efficient dwelling. Continued progress in design and construction has made the home of today far more efficient and more economical to maintain than the house of the 80's.

Continued progress has also created the Sullivan Series 100 air compressor, an advanced conception of industrial compressor design and operation. In the Series 100, Sullivan engineers have embodied advance principles of design and have incorporated into an industrial air compressor the same precision construction that characterizes the automotive and aircraft industries.

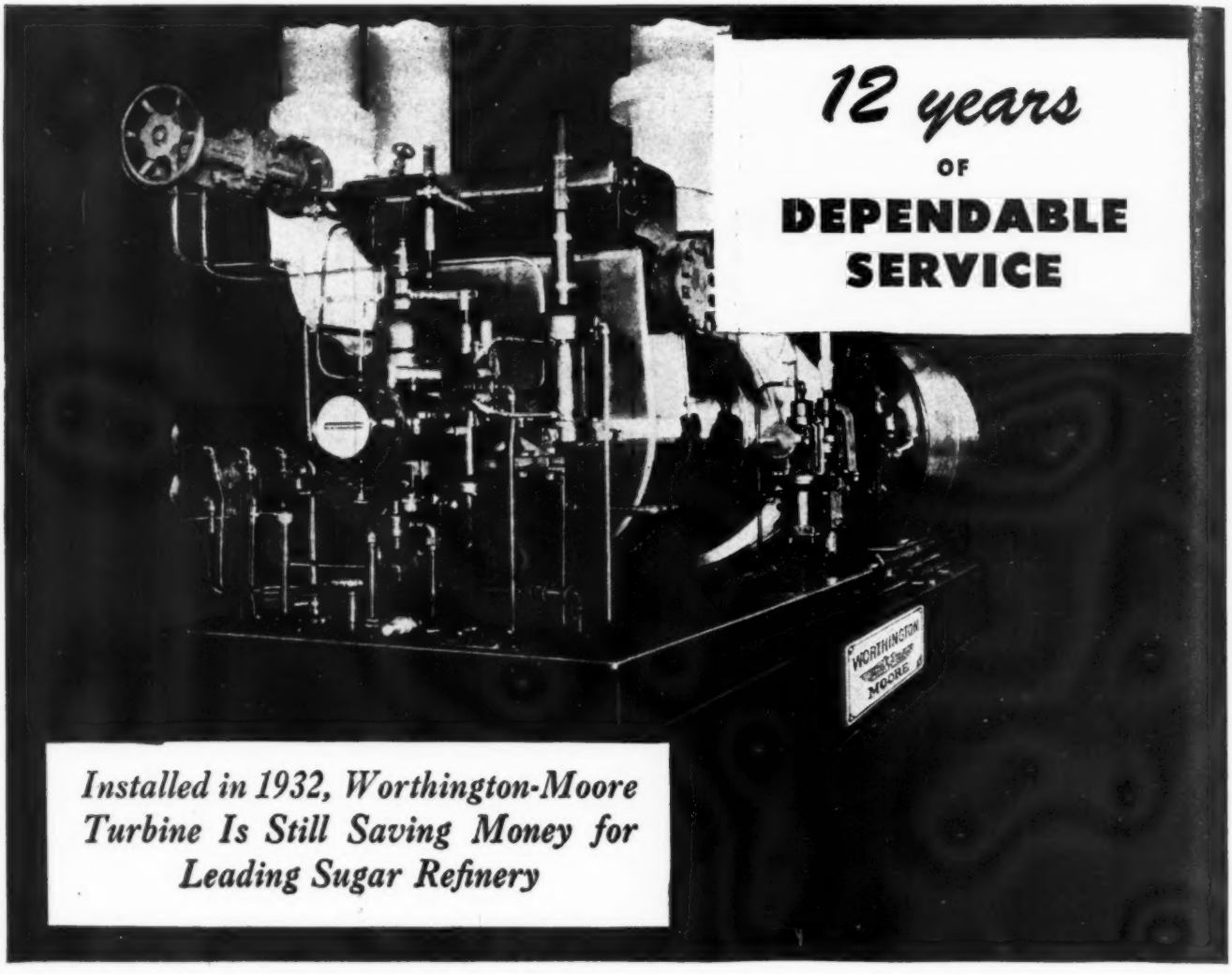
As a result, the Series 100 compressor, proved by acceptance in every type of industry since its introduction in 1937, is leading a new trend in compressor design. Sullivan Series 100 compressors are compact; they are shipped intact, ready to hook up to air, power and water lines; they are adaptable to electric, diesel or steam power. Most important, however, Sullivan Series 100 air compressors are built to give continuous, heavy-duty, 24 hour a day service far more economically than has ever before been possible.

Only the Series 100 compressor can offer all the advantages and operating economies of modern design and construction. Years from now, when all industrial air compressors are patterned after these, you'll be glad you selected Sullivan. Bulletin A-52 will interest every man who thinks progressively. The nearest Sullivan branch office will gladly send your copy. Sullivan Machinery Company, Michigan City, Indiana. IN CANADA: Canadian Sullivan Machinery Co., Ltd., Dundas, Ontario.

OFFICES—Birmingham • Boston • Butte • Chicago • Dallas • Denver • Detroit • Duluth • El Paso • Huntington • Knoxville • Los Angeles • New York • Philadelphia • Pittsburgh • Portland • Salt Lake City • San Francisco • Scranton • Seattle • Spokane • St. Louis

PRODUCTS—Stationary and Portable Air Compressors from ¼ to 3000 H. P. • Pneumatic Casting Grips • Foundation Breakers • Portable Hoists • Rock Drills.

AIR COMPRESSORS
From ¼ to 3,000 H.P.
by
SULLIVAN
FACTORIES-MICHIGAN CITY, IND. AND CLAREMONT, N.H.
Sullivan Series 100 Air Compressors are available in nine models, from 378 to 3636 C.F.M., in twins.



Installed in 1932, Worthington-Moore Turbine Is Still Saving Money for Leading Sugar Refinery

Dan Gutleben, engineer for the Pennsylvania Sugar Company, recently wrote: "Our Worthington-Moore turbine rolls along every day and every night without stopping. It ran for years with very few shut-downs and no service expense whatever."

Electricity a By-product

This 2000 KW turbine-generator, like many other Worthington-Moore units, produces low-cost electricity as a by-product. It operates on steam at 400 lbs. pressure, 500°F. total temperature, 12 lbs. back pressure and automatically extracts steam at 90 lbs.

Engineering the Right Turbine for the Job

Experienced in special turbine applications, as well as in a wide range of related steam power plant equipment, Worthington-Moore engineers are especially fitted to recommend the best type of unit for your particular requirements. *Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, New York.*

WORTH BEHIND THE NAME
WORTHINGTON

MOORE

MR4-4

A GREAT TEAM IN STEAM

Specify Ladish *Controlled Quality* Forged Steel Pipe Fittings

Ladish forged steel fittings, carbon and alloy, are produced under exacting metallurgical control. Every Ladish fitting bears the symbol of Controlled Quality—the Ladish Heat Code.

Forged Steel Screwed Fittings

Full depth thread, accurately cut, results in pressure-tight joints. Pipe enters easily. Uniform thickness. Sizes clearly marked . . . ⅛" through 4".

Socket Welding Fittings

Speed up installation because deep sockets save time formerly required to cut pipe to exact length. Socket supports pipe and allows self-alignment. No machining of pipe necessary for fit. ASSURED WELDABILITY. Sizes clearly marked . . . ⅛" through 4".

TO MARK PROGRESS

ARMY NAVY

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN

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New York Office: 60 E. 42nd Street, New York City

Houston, Texas Office: 1005 Sterling Building

District Offices: Lincoln Bldg., New York City • Rockefeller Bldg., Cleveland, • Peoples Gas Bldg., Pittsburgh • Sterling Bldg., Houston • Petroleum Bldg., Los Angeles

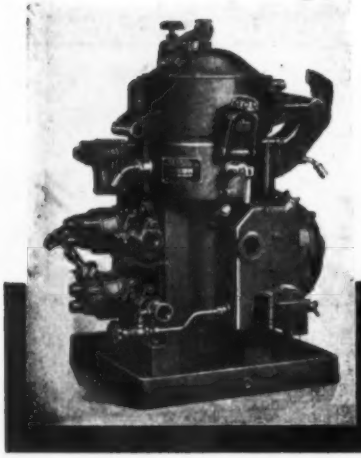
MODERN POWER UNITS NEED DE LAVAL-PURIFIED OIL

LITTLE or no thought need be paid to lubrication of the picturesque old windmill but today's turbines and engines require that the lubricant be kept in practically "new oil" condition all the time. The surest way to keep oil in this condition is to by-pass a portion of it continuously through a De Laval Oil Purifier.

De Laval centrifugals remove instantaneously the impurities normally collected in service — water, sludge, carbon or dirt. The design of the De Laval bowl enables these foreign materials to be most completely centrifuged out of the oil, leaving the lubricant so thoroughly purified that its effectiveness remains unimpaired for indefinitely long periods.

There are De Laval Oil Purifiers for power plants of every size and all assure the same high degree of protection to bearings and to other vital moving parts.

Additional details will gladly be sent upon request.

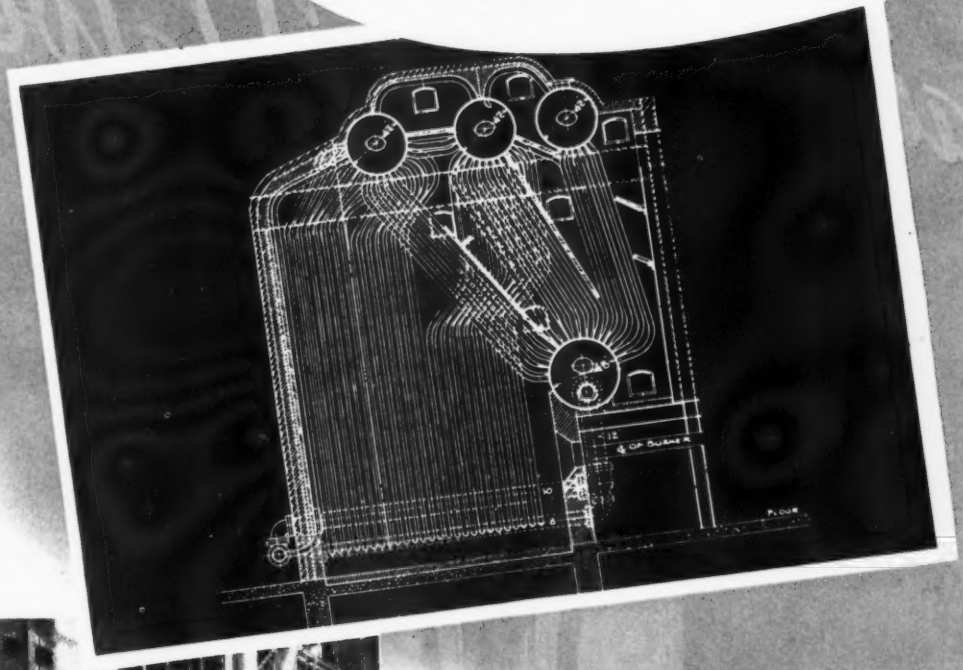


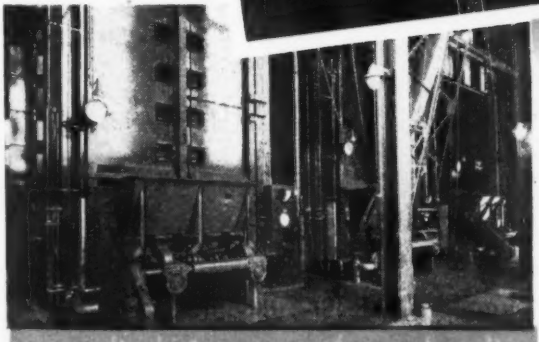
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 — 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL — PETERBOROUGH — WINNIPEG — VANCOUVER

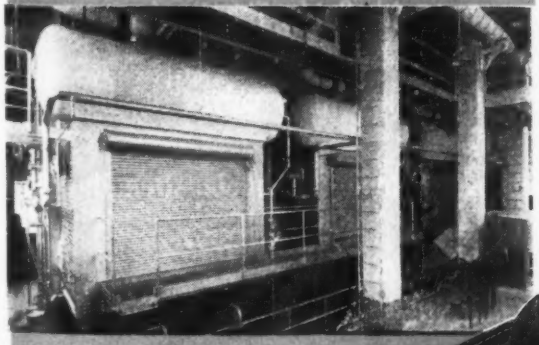
DE LAVAL OIL PURIFIERS

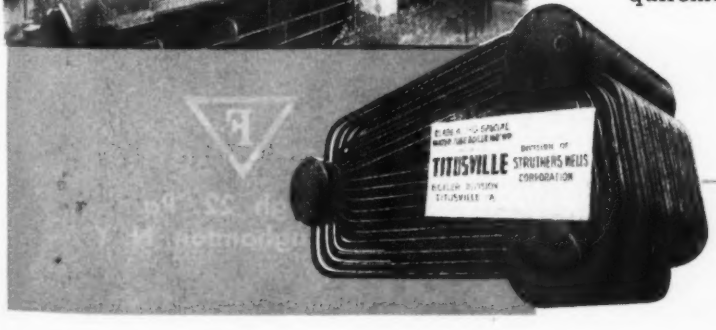
Since 1860

TITUSVILLE Water Tube BOILERS









...have been first choice for reliable...low cost

HEAT and POWER

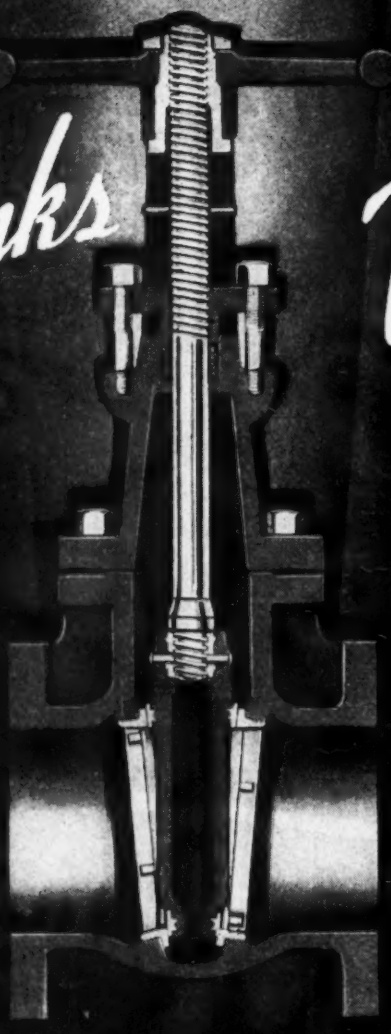
The *advanced engineering* in Titusville Boilers embody such important features as: application of higher tensile strength metals to meet extreme temperatures and pressures; more compact design to afford maximum heat action with minimum fuel consumption; baffles, cleanouts and tube removal arrangements located for easier access; latest developments in welding; all construction to meet ASME Codes and state or local regulations.

Call on Titusville engineers anytime, anywhere for the economical answer to your specific Boiler requirements.

THE TITUSVILLE IRON WORKS COMPANY

Division of Struthers Wells Corporation
TITUSVILLE, PENNSYLVANIA
Offices in Principal Cities

Fairbanks Valves



Fairbanks Iron-Body O. S. & Y. Gate Valves give an unobstructed full flow.

Having an outside screw and yoke, the operating threads on stem are outside the bonnet, consequently they are entirely removed from contact with fluids. This is of particular value in handling acids or abrasives which might wear the threads.

For use on corrosive services which attack bronze trimmings, these valves can be supplied in all-iron construction.

Their extreme ruggedness and uniform wall thickness provide adequate strength resistance to distortion.

Made for 125 and 250 lb. S.W.P. and 400 lb. W.O.G. pressures.

Write for name of our nearest distributor and Catalog No. 42 showing complete line of Fairbanks Bronze and Iron Valves.

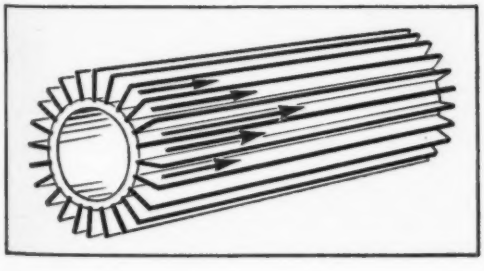
THE FAIRBANKS COMPANY

393 Lafayette St., New York 3, N. Y.

520 Atlantic Ave., Boston 10, Mass. • 15 Ferry St., Pittsburgh 22, Pa.
748 M. & M. Bldg., Houston 2, Tex. • Factories: Rome, Ga. and Binghamton, N. Y.

THE G-FIN STORAGE TANK OIL HEATER
These units can be furnished for installation either inside or outside of the storage tank.

Why Heavy Oil Flows Freely From These Storage Tanks



LEAST PRESSURE DROP . . . because the liquid to be heated passes without change in direction along the straight channels provided by the longitudinal G-FINS of the heating elements, with maximum free area for flow of oil through the heater. This is one of the 10 major superiorities of the G-Fin Storage Tank Oil Heater described in Bulletin 1641 which will be sent on request.

No matter how cold the weather, nor how viscous the oil, a G-FIN Storage Tank Oil Heater assures *speedy* flow of oil, because of the effectiveness of its G-Fin elements, which have 5 times the heat transfer surface of a plain tube or pipe occupying the same cross-sectional area.

Moreover, the flow of oil is dependably *continuous*, because the design of this heater prevents vapor binding or stratification of the hot oil or vapor.

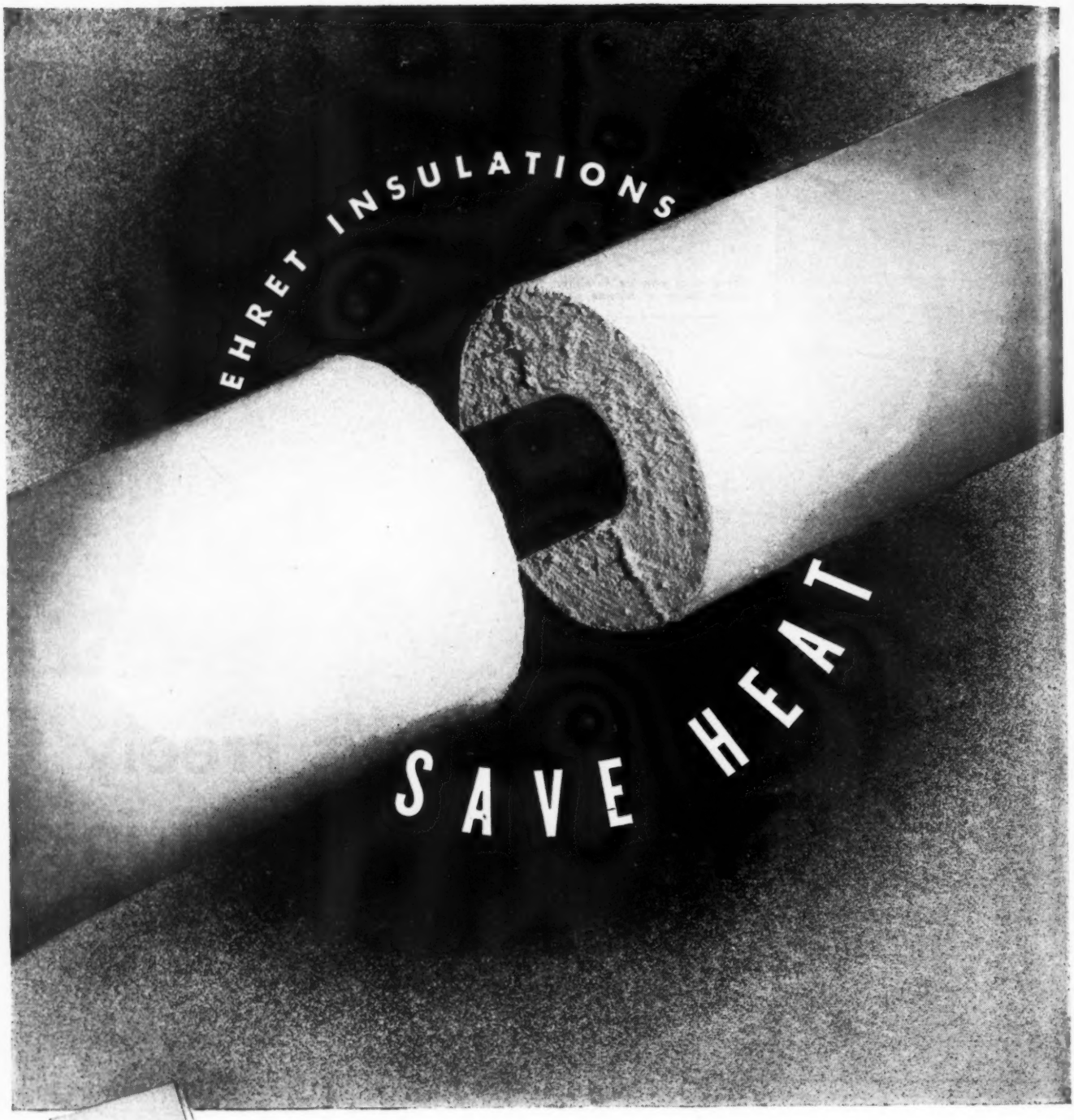
Many thousands of G-Fin Storage Tank Oil Heaters are in use at storage tanks, service tanks, loading wharves or platforms, chemical plants, gas plants . . . wherever fuel oil, lubricating oil, crude oil, tar, asphalt, road oil, cottonseed oil, molasses; or other viscous liquids are stored . . . and their rapidly increasing use demonstrates their uniformly successful service.

THE GRISCOM-RUSSELL CO.

285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



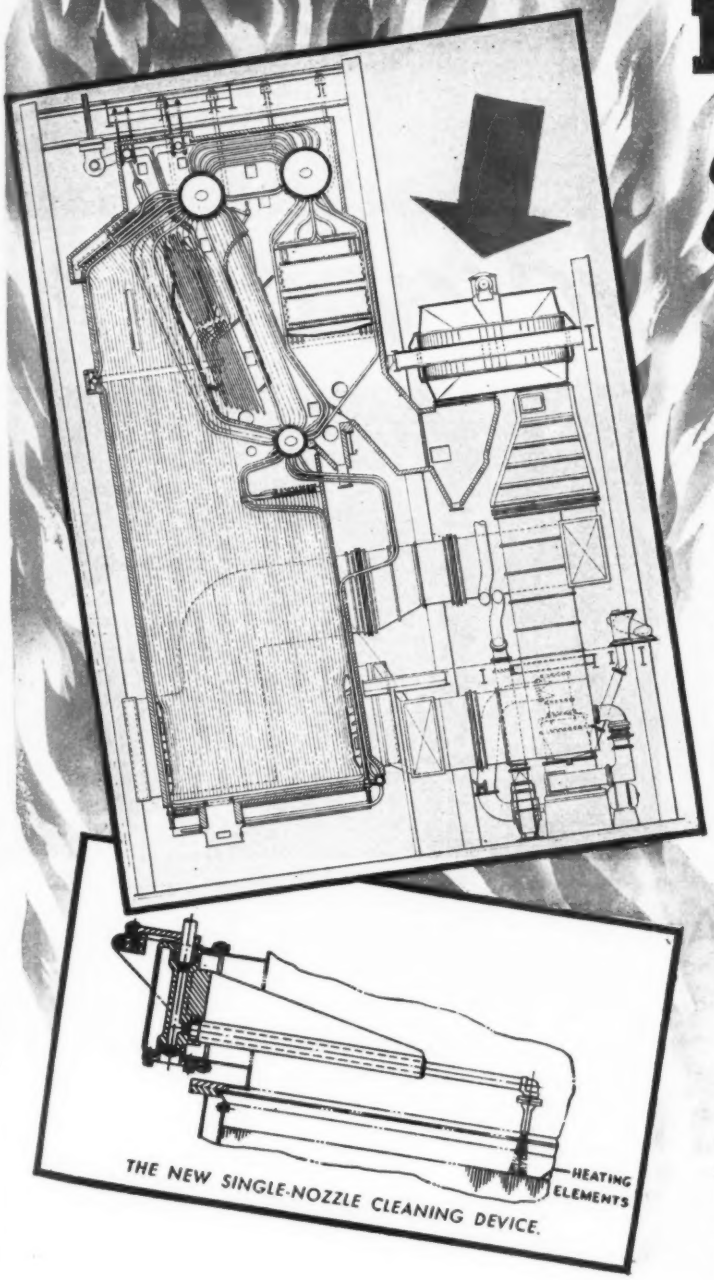
EHRET'S 85% MAGNESIA and many other Ehret heat insulating materials are fully treated, both as to selection and application, in the 176-page Heat Insulation Handbook. Write today for your copy.

More than half a century ago, when steam pipes were "covered" with mixtures of sawdust or old rope and plaster of Paris, there was little realization of the true value of insulation. How times have changed!

The power engineer of today is not only fully aware of the necessity of using insulations that are highly efficient when applied, but he is especially concerned with choosing an insulation that will *maintain* its efficiency, year after year, for its entire service life. This is one of the reasons why Ehret's 85% Magnesia has long been specified for temperatures up to 600° F. and Ehret's Enduro up to 2000° F. In fact, the demand for these two Ehret Insulations is greater today than ever before.

EHRET MAGNESIA MANUFACTURING CO. • VALLEY FORGE • PENNSYLVANIA

NOW even better results from poor fuels with PREHEAT Engineering



THE NEW SINGLE-NOZZLE CLEANING DEVICE.

Problems presented by poor fuels hold fewer complications for boiler plants and industrial furnaces whose heat-recovery efficiency has been boosted by Preheat Engineering. High temperature combustion air is the key factor to efficient combustion of low-grade fuels with high ash and moisture content, and excessively lean fuels such as blast-furnace gas. In addition to economies effected by heat recovery, more efficient furnace design is made possible by preheated combustion air. It is a "must" for firing with pulverized coal.

ENGINEERING SERVICE

The engineering staff of The Air Preheater Corporation is prepared to assist you in applying the standard or special types of Ljungstrom Preheaters to your fuel conservation needs, or to help you convert your plant so as to get the most from low-grade, more abundant fuels.

The continuing decrease in fuel quality brings with it, in some cases, an unavoidable increase in deposit formation on the cold end of the preheater heating surface. To remove these deposits on the Ljungstrom, The Air Preheater Corporation has developed a new, single-nozzle cleaning device based on the mass blower principle. This high-efficiency cleaner has, for the past six months, kept a double-height preheater which was operated with exit gas temperatures below the dew point, completely free from the deposit formation.

Standard equipment on all new Ljungstroms, the new single-nozzle cleaner is available for immediate installation on existing units. You are invited to write for complete information.

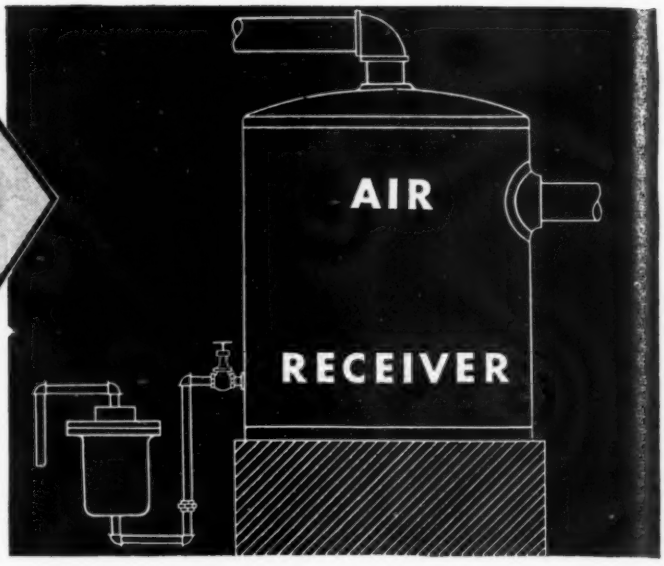
THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York

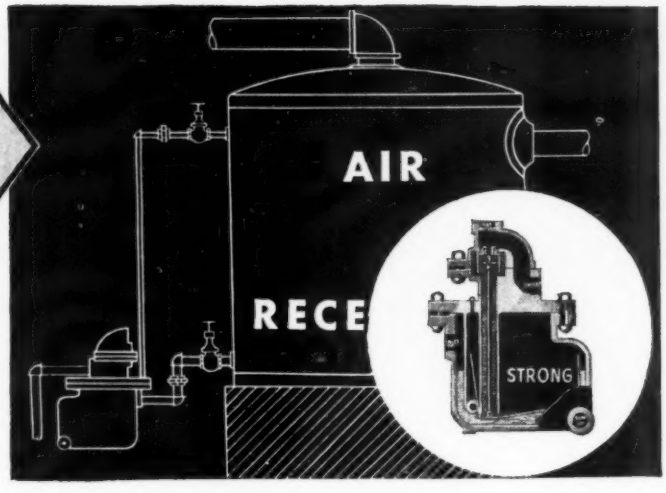
PROBLEM:
PREVENT WASTE OF AIR
(or other incondensible gas)
IN DRAINING SYSTEM



Using inverted bucket traps: This type of trap is ideal for steam service, particularly where it is necessary to remove air as well as condensate. The fact that these traps do discharge air, makes them undesirable for systems where no air or other non-condensible gas should be wasted.

How Would YOU DO it?

Here's STRONG'S *Suggestion*



Using open bucket trap with equalizer between trap and receiver or line being drained. No gas is lost when trap discharges, because liquid in discharge tube forms liquid seal between gas (or air) and discharge valve. Strong open bucket traps available for use with water, ammonia, brine, gasoline, oil, etc.

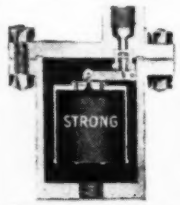
Both KNOWING the Answer—and HAVING It!

The fact that the Strong line includes open *and* inverted bucket traps—as well as other types—means that our engineers can look for the best answer to your problem, knowing that the complete line of Strong steam specialties includes the equipment that answer calls for.

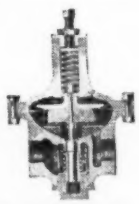
Their suggestions are backed by long experience with the complete Strong line, which includes open and inverted bucket, closed float, float-and-thermostatic (blast) traps, etc.—forged, fabricated (welded), cast and semisteel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland 13, Ohio.

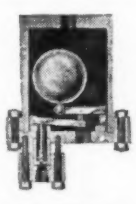
STRONG, CARLISLE & HAMMOND COMPANY
Cleveland 13, Ohio

OTHER
STRONG
STEAM SPECIALTIES

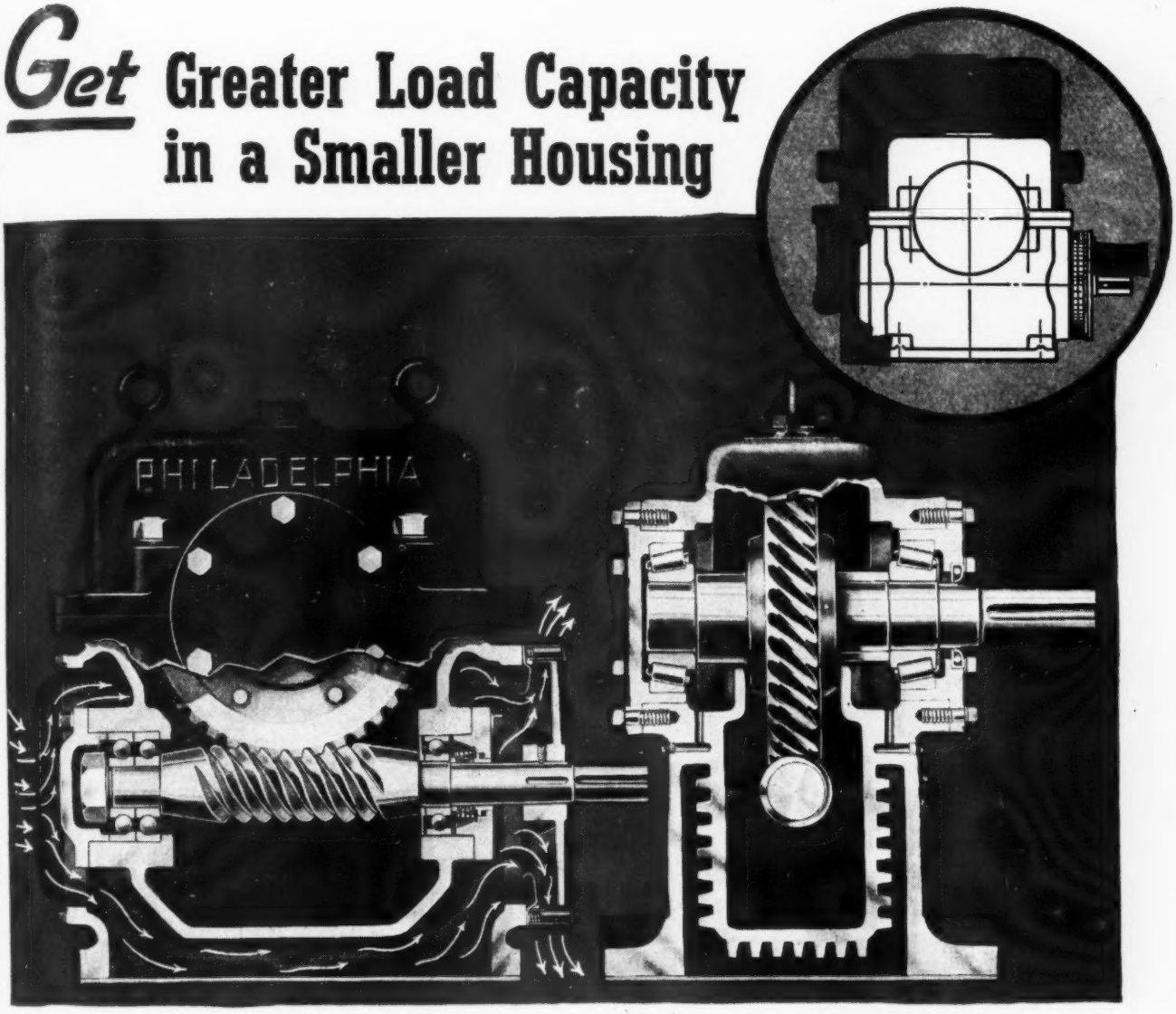


Welded Steel Traps


Reducing Valves


Float Traps

Get Greater Load Capacity in a Smaller Housing



...with the Philadelphia AIR KOOLED Worm Gear Speed Reducer

At the upper right is shown the comparative sizes of a size 675 Type AT standard unit (in blue) and a size 475 AirKooled unit. Both deliver 20 HP at 1750 RPM. Ratio 4 6/7 to 1.

The cut-away drawings show the double-walled, finned housing and the flow of air around the oil reservoir.

Considerable *space* and *weight* savings have been made possible by the design of Philadelphia AirKooled Worm Gear Reducers as compared with standard heavy duty type worm gear units.

The AirKooled design features a suction fan, mounted on the worm shaft, which draws air through the double-walled, finned housing. This dissipates generated heat, and thereby maintains a higher contact oil film strength and greatly increases the horsepower ratings at worm speeds of 580 and 1750 RPM. For all ratios at 1750 RPM the ratings are approximately doubled, so the AirKooled unit is about two sizes smaller than a standard unit of the same capacity.

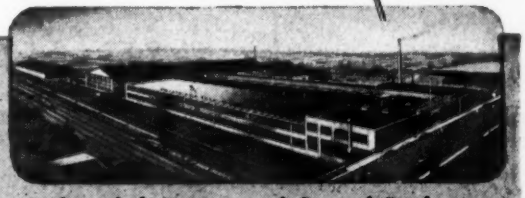
Let us tell you what these savings can mean to you.

SEND FOR BULLETIN 250 .... *on your Business Letterhead*

ARMY E NAVY

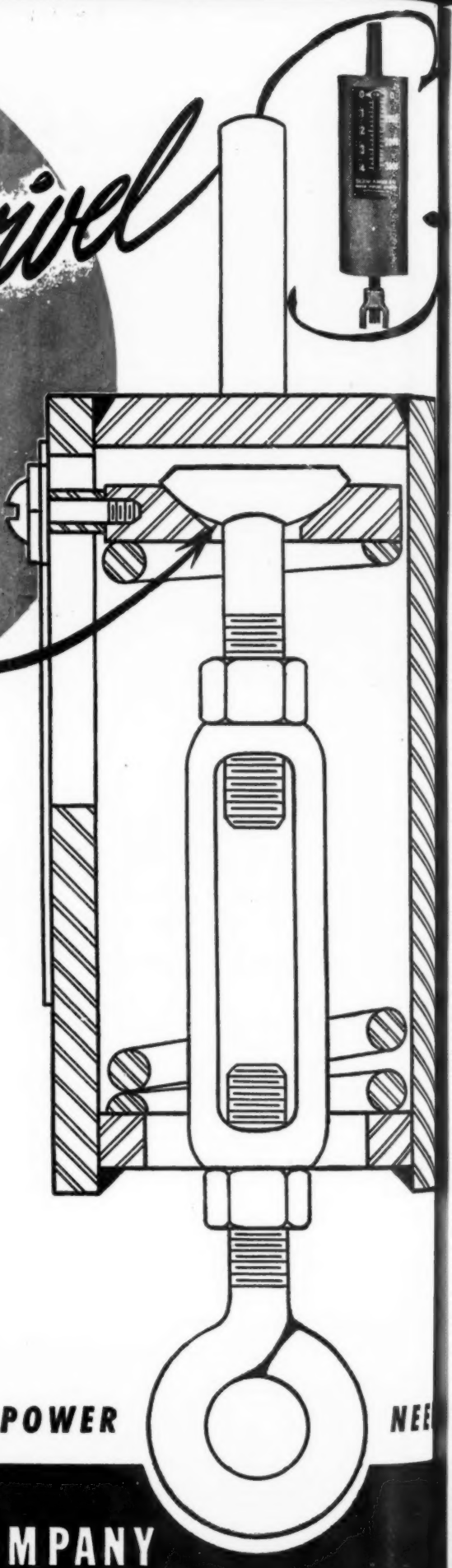
Philadelphia GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK • PITTSBURGH • CHICAGO



Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Exclusive Internal Swivel action



POWER PIPING
FUNCTIONAL HANGERS

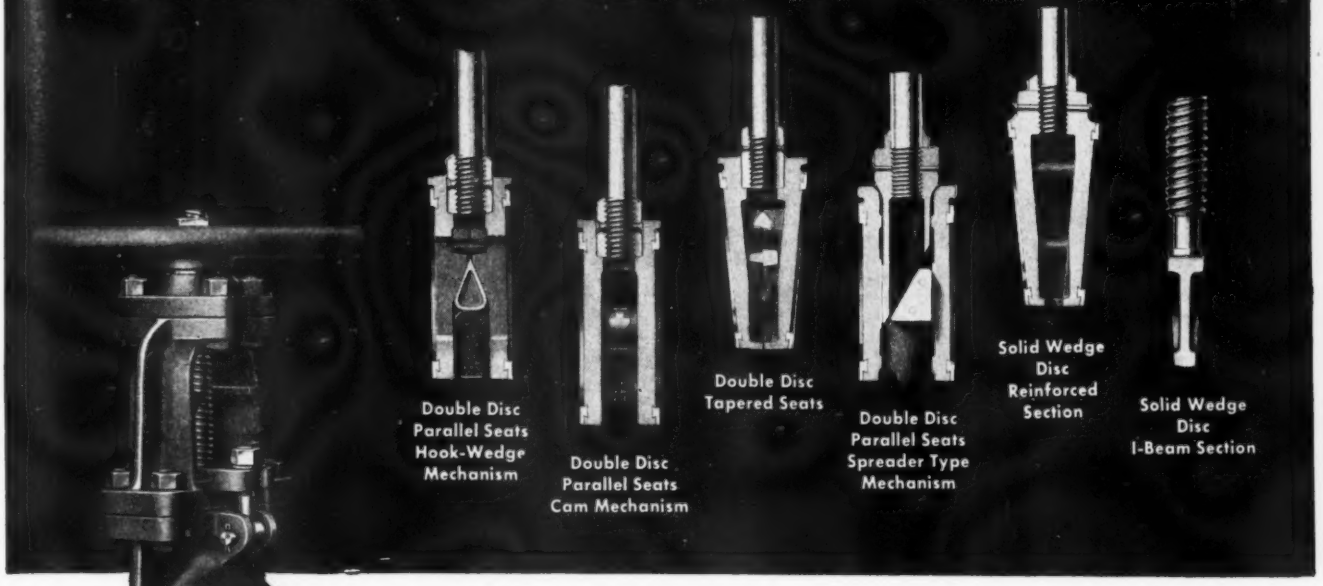
- **SCALE**—Actual load indicated in Lbs. at all times.
- **SPRINGS**—Totally enclosed and guided.
- **ROD**—Pivotal action, swings freely with complete lateral and longitudinal movement, permitting short headroom installation. This internal swivel action is a patented feature.
- **SHORT HEADROOM**—Turnbuckle adjustment *11⅛" minimum for any load.

*FLEX-ANAL CHARTS and HANGER BULLETIN 1863 save time in engineering manpower. Copies of these books can be obtained through a request on your business letterhead.

FIT ALL MARINE & POWER NEE

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

GATE VALVE DISCS



Kennedy O. S. & Y. Standard Iron Body Wedge Gate Valve with Flanged Ends

WHAT'S YOUR PREFERENCE?

They're all in the KENNEDY line

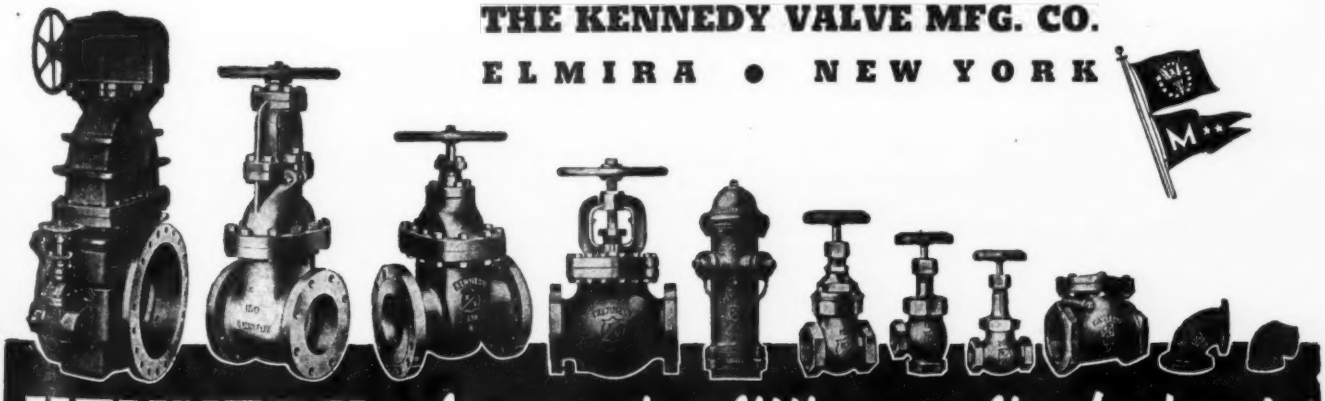
Solid wedge with cored or I-beam construction . . . double disc with parallel or taper sides . . . whatever may be your preference of discs for iron-body gate lines . . . are all available in different types of valves included in the extensive Kennedy line.

And if you would like advice as to the most suitable type for your particular requirements, the Kennedy engineers are prepared to offer authoritative recommendations, based on their long experience in designing valves for every standard requirement.

The Kennedy line includes iron-body and bronze gate, globe, angle and check valves, cast iron flanged fittings and flanges, malleable iron and bronze screwed fittings, and many valve specialties . . . all described in the 240-page Kennedy catalog which will be sent on request.

THE KENNEDY VALVE MFG. CO.

ELMIRA • NEW YORK

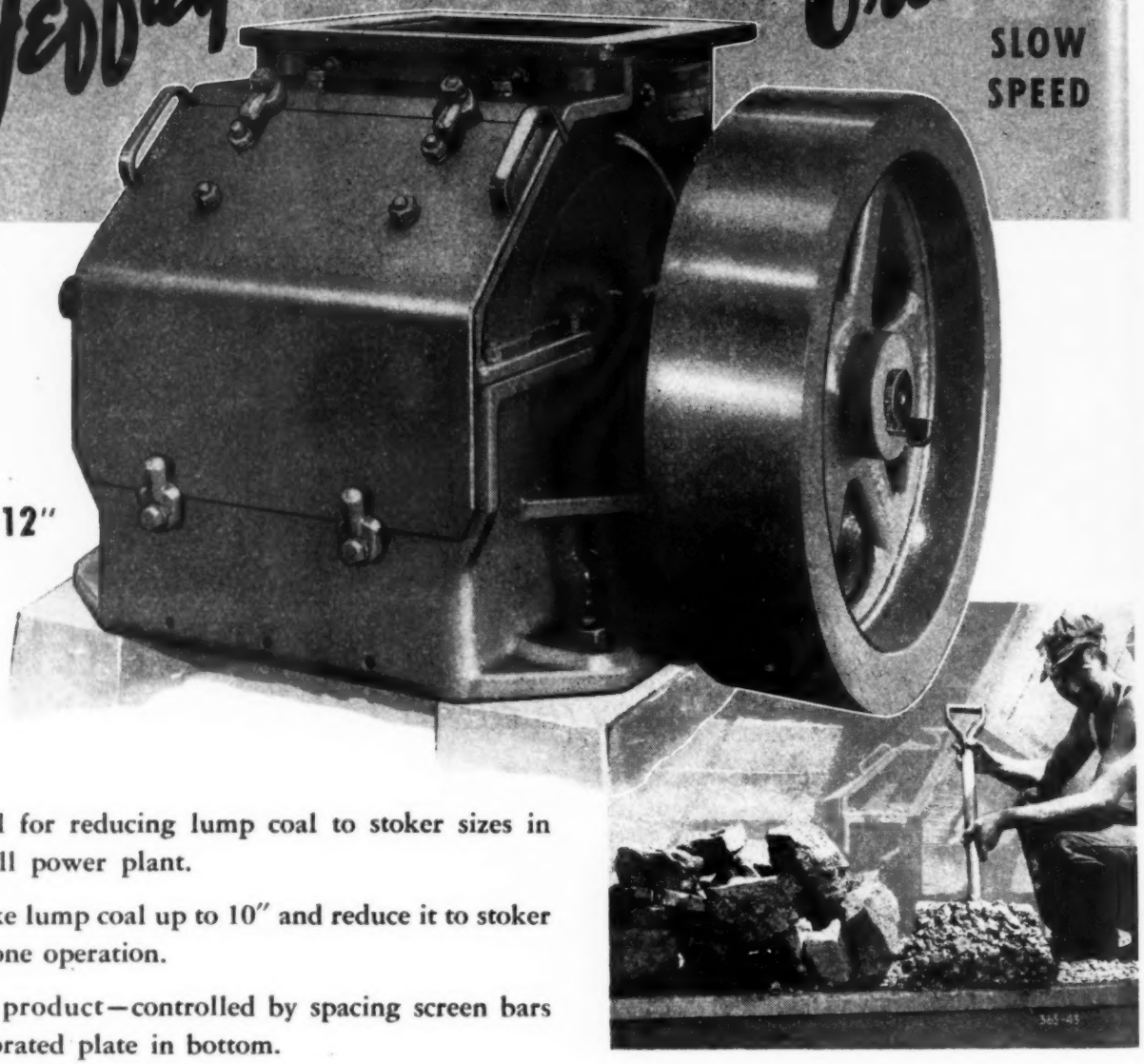


KENNEDY *valves . . . pipe fittings . . . fire hydrants*

Jeffrey FLEXROLL COAL Crusher

SLOW SPEED

Patented



● Ideal for reducing lump coal to stoker sizes in the small power plant.

Will take lump coal up to 10″ and reduce it to stoker size in one operation.

Size of product—controlled by spacing screen bars or perforated plate in bottom.

Crushing principle—three rolls mounted between two revolving discs keyed to large diameter shaft. Rolls are free to turn and are held in their outer or crushing position by centrifugal force.

Small power consumption—low maintenance cost.

Jeffrey also has available larger, higher capacity crushers for reducing coal and other material. Consult us on your crushing needs.

ILLUSTRATING the results obtained with this Jeffrey Flexroll crusher—comparing feed size and crushed product.

A DISTINCTLY NEW TYPE

"Ideal for taking oversize from screen where present crusher is overloaded in closed circuit."

An INEXPENSIVE small capacity unit for reducing lump coal to stoker sizes in a single operation.

THE JEFFREY MANUFACTURING COMPANY

(ESTABLISHED IN 1877)

932-99 NORTH FOURTH STREET • • COLUMBUS 16, OHIO

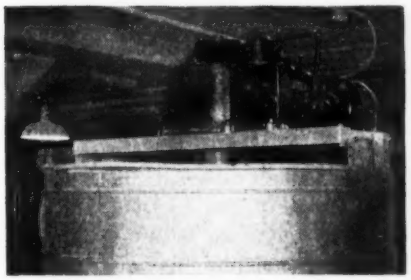
SALES OFFICES: Baltimore 1, Birmingham 3, Boston 16, Buffalo 2, Chicago 1, Cincinnati 2, Cleveland 13, Denver 2, Detroit 13, Harlan, Houston 5, Huntington 19, Milwaukee 11, New York 7, Philadelphia 3, Pittsburgh 22, St. Louis 3, Salt Lake City 1, Scranton 3

Built to stand the 24 hour a day drive for victory

● Type H Heavy Duty Worm Gear Reducers driving 54-in. and 48-in. tumbling mills in steel foundry. Ratio 11-1/3 to 1 and 7-3/4 to 1.

TODAY every phase of war work calls for drives that will stay on the job. Jones Worm Gear Speed Reducers have been built for long, trouble-free service. And the records established by these speed reducers in 24 hour a day service show that they have the ruggedness and stamina for which all Jones Transmission Products are known.

For complete information on Jones Worm Gear Speed Reducers ask for Bulletin No. 68 and for Worm-Helical Reducers ask for Bulletin No. 75.



● Jones Worm-Helical Speed Reducer driving a lacquer agitator. A simple design prevents leakage of oil along the vertical low speed shaft.

W. A. JONES FOUNDRY & MACHINE CO.
4423 Roosevelt Road, Chicago, Illinois

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES • ANTI-FRICTION PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES

RATIOS AND CAPACITIES

Jones Worm Gear Reducers are built in ratios from 4 to 1 up to 90 to 1 and in capacities from ¼ to 100 H.P.

Jones Worm Helical Reducers for vertical shaft drives are built in ratios from 40 to 1 to 250 to 1 for all common motor speeds and a wide range of horsepower ratings.

THE *Modern* METHOD OF JOINING COPPER AND BRASS PIPE

WHERE EXPANSION AND VIBRATION PREVAIL

SAFEGUARD YOUR PIPE LINES WITH *Silbraz** Joints

VALVES FLANGES FITTINGS

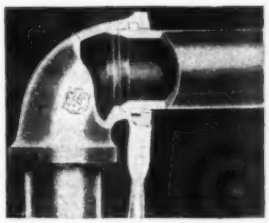
For any services where extremes of temperature or vibration are encountered, you can prevent piping trouble by specifying Silbraz joints on all copper and brass pipe or tubing. These threadless, modern joints — made with Walseal bronze valves, fittings, and flanges — won't creep or pull apart under any temperature, shock, or pressure which the pipe itself can withstand. Silbraz joints remain tight and leak-proof under punishment far greater than that encountered in normal industrial services.

Proof of the unusual stamina of Silbraz joints is found in their outstanding performance on fighting ships, tanks, and other war equipment.

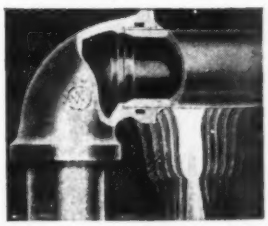
Easily made up by oxyacetylene flame brazing, Silbraz joints require neither maintenance nor repairs. They make every pipe line in which they are used a leak-proof, truly "one-piece" line. Be sure to send for a free copy of Catalog 42 for a full description of Walseal valves, fittings and flanges for making Silbraz joints.

*Registered trade marks

After cleaning and fluxing pipe and fitting, insert pipe into fitting up to shoulder. Then expand pipe by heating with the oxyacetylene flame.



Heat a section of the fitting, directing flame toward pipe or tubing. This causes section of fitting to expand, allowing alloy to flow.



Heat both pipe and fitting with a wiping motion of torch. Remove flame. Fitting contracts, alloy flows and forms ring at fitting edge, completing Silbraz joint.

MAKE IT A "ONE-PIECE PIPE LINE" WITH WALSEAL

BOSTON WORKS
KEWANEE WORKS

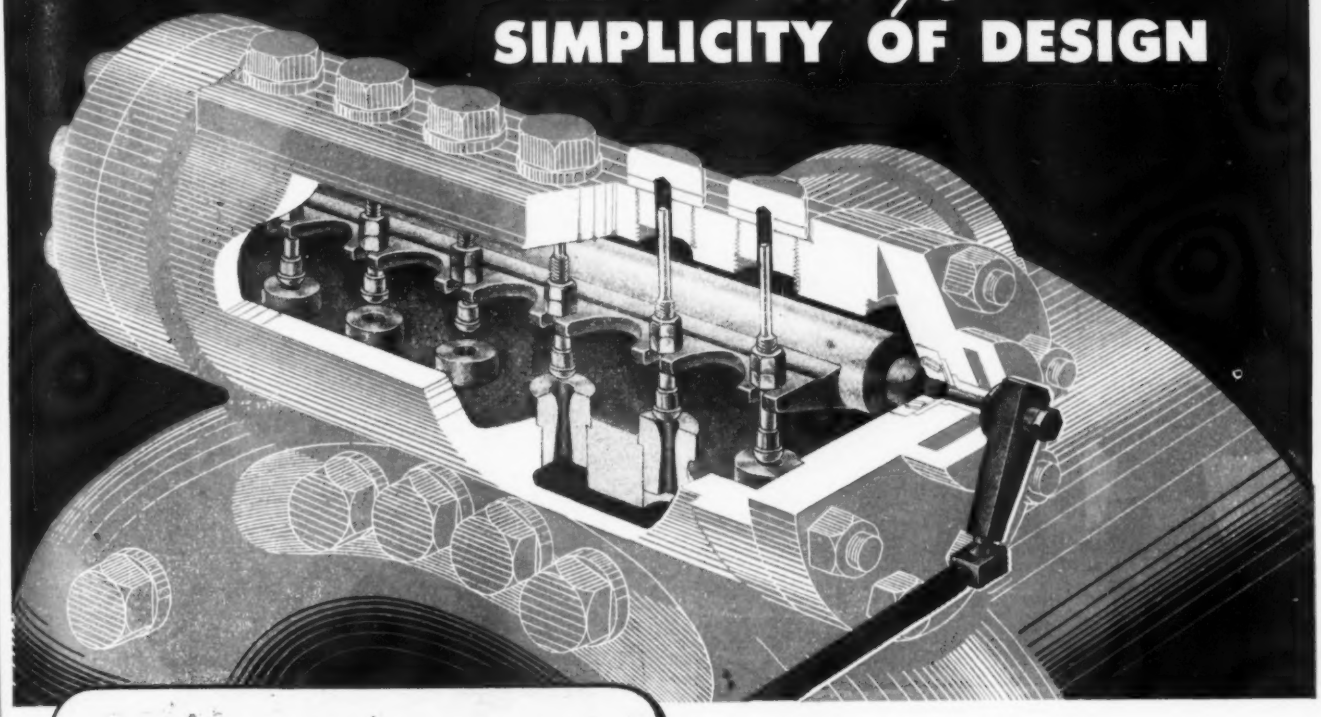
WALWORTH

valves AND fittings

60 EAST 42nd ST., NEW YORK 17, N. Y.

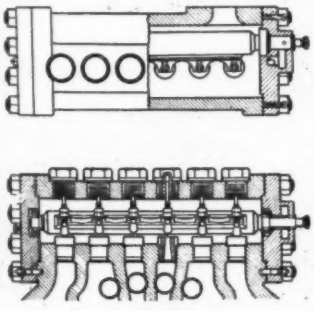
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

SENSITIVITY OF CONTROL *through* SIMPLICITY OF DESIGN



This HENDY Turbo-Generator feature will pay you dividends

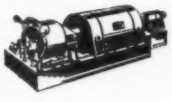
The steam-control valve mechanism of the Hendy turbo-generator is operated by a rocker shaft. In this design there are no valve stems or lifter-bar mechanisms passing through the steam chests; thus friction loss is eliminated and the sensitivity of the system is correspondingly increased. The stainless-steel rotating shaft that lifts each valve successively from its seat is carried in nitrided bearings, insuring free operation in high temperatures and eliminating shaft stuffing or packing boxes.



Because of the extreme simplicity of this design, valve adjustments are easily made, and heavy rocker arms, lengthy control linkages, and wasteful steam leakages are eliminated.

This worth-while Hendy feature is only one of many that contribute to lower maintenance costs, greater efficiency in operation—that pay you dividends. Watch succeeding advertisements for details of other dividend-paying Hendy features.

Further descriptive information is available. When requesting detailed information and prices please indicate electrical requirements, steam conditions, and type of service involved.



Developed recently to meet war needs for a matched turbo-generating set of utmost reliability, Hendy turbo-generators are setting new high standards of performance. By simplification of design *throughout*, operating efficiencies are *raised* and maintenance and service problems are *reduced*. Built in one of America's best equipped shops by a corps of skilled craftsmen, these units feature many advancements in turbine, reduction-gear and generator design . . . combined into one complete plant that has received immediate approval by operating engineers.

Hendy turbo-generating plants are available for marine or stationary applications in sizes from 250 to 750 kw. Investigate *now* the many advantages to you of installing Hendy equipment.

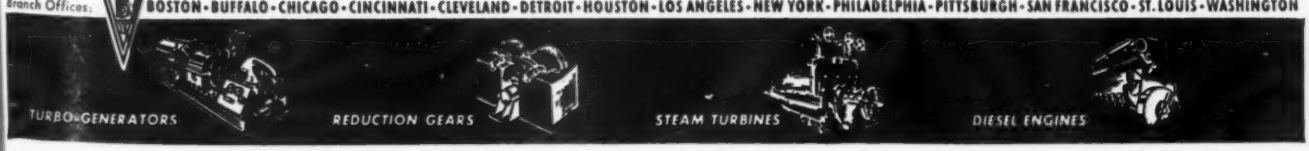
JOSHUA HENDY IRON WORKS

ESTABLISHED 1854

SUNNYVALE, CALIFORNIA

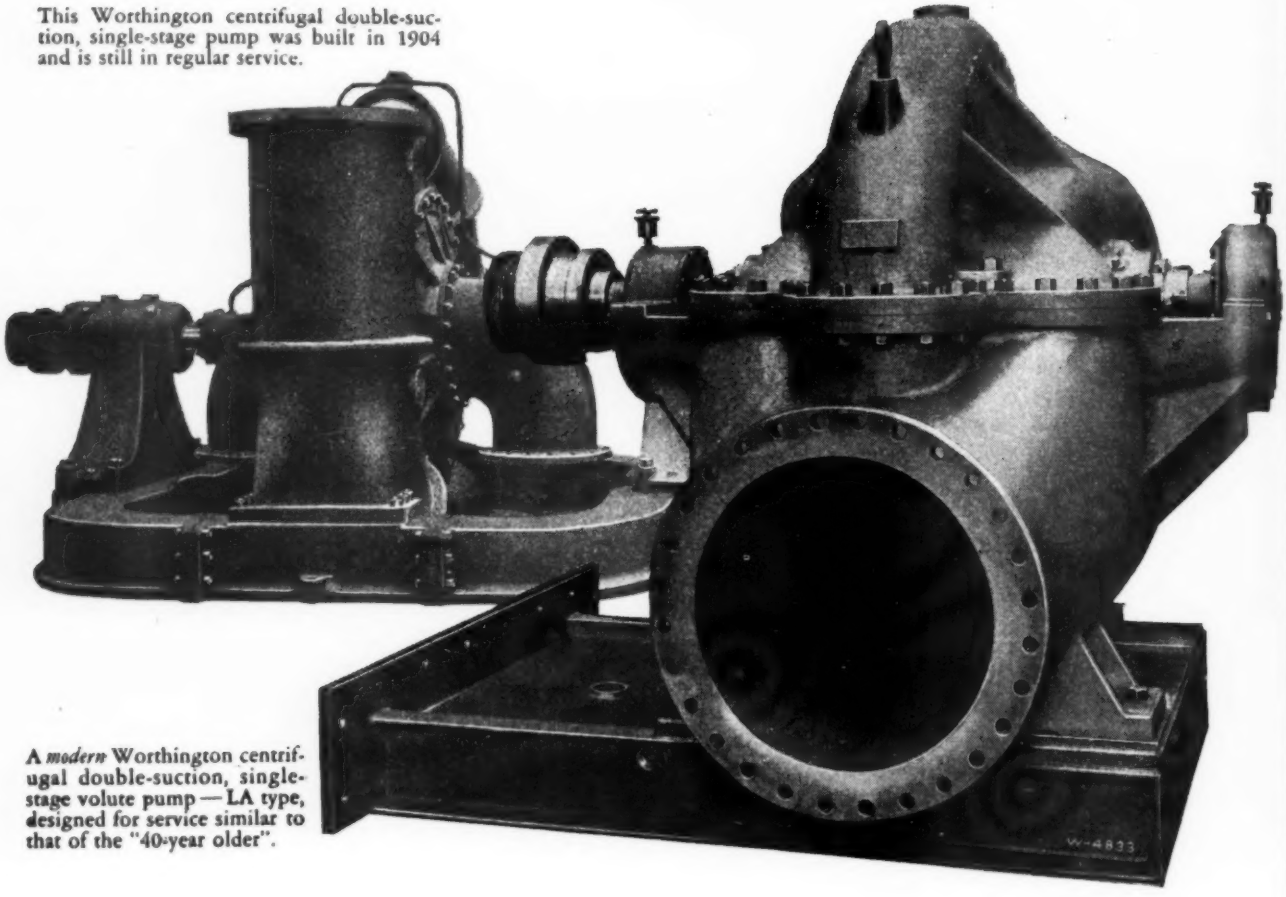
56-YB-6

Branch Offices: BOSTON · BUFFALO · CHICAGO · CINCINNATI · CLEVELAND · DETROIT · HOUSTON · LOS ANGELES · NEW YORK · PHILADELPHIA · PITTSBURGH · SAN FRANCISCO · ST. LOUIS · WASHINGTON



IF LIFE BEGINS AT FORTY . . .
ITS BEST YEARS ARE STILL AHEAD

This Worthington centrifugal double-suction, single-stage pump was built in 1904 and is still in regular service.



A *modern* Worthington centrifugal double-suction, single-stage volute pump — LA type, designed for service similar to that of the "40-year older".

. . . *for Worthington Builds Pumps to Last*

The two Worthington centrifugal pumps illustrated at the top of this page offer striking contrasts that show at a glance how far Worthington design and engineering improvements have progressed in the years since the Worthington "40-year older" was built!

BUT . . . in this one important way there has *never* been any change in Worthington pumps . . . from the oldest to the youngest . . . and that is *the high quality of Worthington design and manufacture.* Old or young . . . large or small . . . *all* Worthington centrifugal pumps provide the utmost in dependability and fitness for service. Write us, or call our nearest district office for specific information. *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

MEMBER

BEHIND THE NAME
WORTHINGTON

CP6-39

WORLD'S LARGEST MANUFACTURER OF PUMPS

STEAM

POWER

ROTARY

VERTICAL TURBINE

CENTRIFUGAL

SPECIAL

ANNOUNCEMENT

Effective November 30, 1944, the plant and property, assets and business of the L. H. Gilmer Company were acquired by United States Rubber Company.

Under the new arrangement, the Gilmer organization remains intact, and will continue to function as heretofore. Customer relationships will not be affected. Gilmer representatives, with whom you have dealt in the past, will continue to call upon you; department heads who have been answering your letters, telegrams and telephone calls will be here to serve you; and all the same fine, highly-specialized Gilmer Belts will be available.

The advantages of this change are many—to you and to the L. H. Gilmer Company. To our research and laboratory development there is now added the vast technical resources of United States Rubber Company. And the enlarged facilities of the Gilmer plant will enable us to render a more complete service. Today, Gilmer stands in a better position than ever before to supply your belting needs.

The L. H. Gilmer Company appreciates the patronage of its many friends, which has contributed much toward making the name Gilmer so well known and highly regarded throughout the world. It is hoped that this pleasant relationship will continue for many years to come.

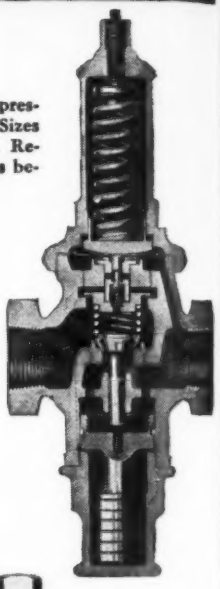
L. H. GILMER COMPANY
Tacony, Philadelphia 35, Pa.
DIVISION OF UNITED STATES RUBBER COMPANY

TAKE THE *Speculation* OUT OF PRESSURE REDUCING PERFORMANCE . . . use Masoneilan Regulators

There's no need to speculate with pressure reducing performance . . . not when you can get accurate, economical control of air, water and steam pressures with Masoneilan Pressure Regulators.

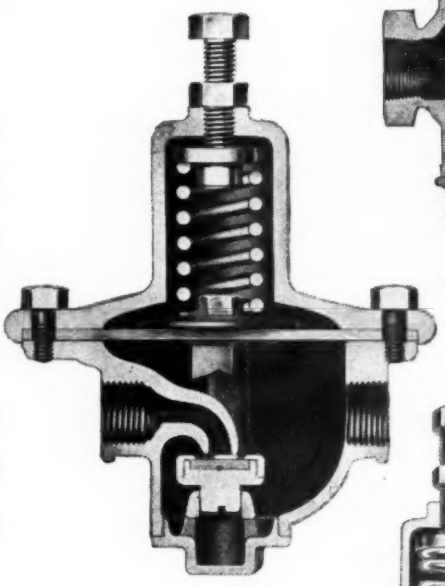
Once installed, these reducing valves give you uninterrupted service year after year under practically all types of operating conditions. They save you money by reducing waste, minimizing time-out of service and cutting maintenance costs.

No matter what your reducing problem . . . always specify Masoneilan Regulators for extra value, for long-lived performance, for low cost. Catalog 73 gives full information. Write for your copy.



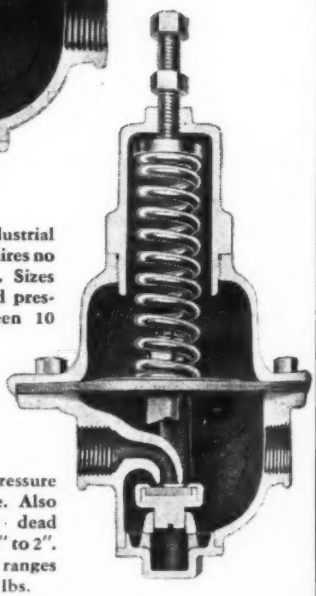
No. 11

For reducing steam pressures. Pilot operated. Sizes — bronze up to 2". Reduced pressure ranges between 5 and 225 lbs.



No. 227

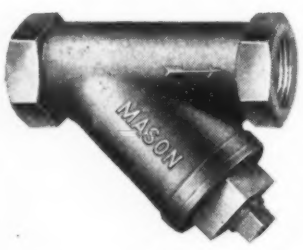
For domestic or industrial water systems. Requires no attention for years. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.



No. 414

For reducing air pressure in industrial service. Also recommended for dead end service. Sizes ¼" to 2". Reduced pressure ranges between 10 and 60 lbs.

MASONEILAN STRAINERS



Prevent scale, dirt, chips, etc. from damaging regulators, traps, valves and pumps . . . use Masoneilan Strainers. These precision-made strainers keep out all foreign matter. They'll eliminate maintenance delays and save you money.

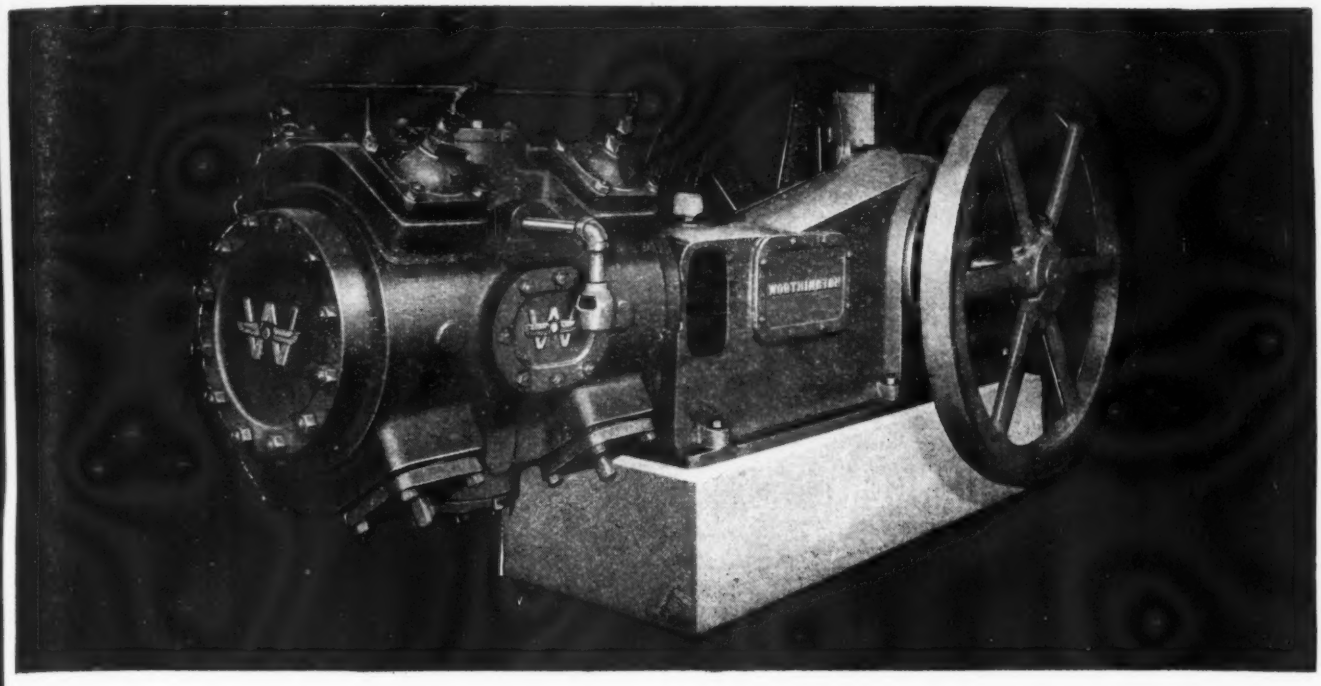
MASONEILAN

MASON-NEILAN REGULATOR CO.

1186 ADAMS ST., BOSTON 24, MASS.

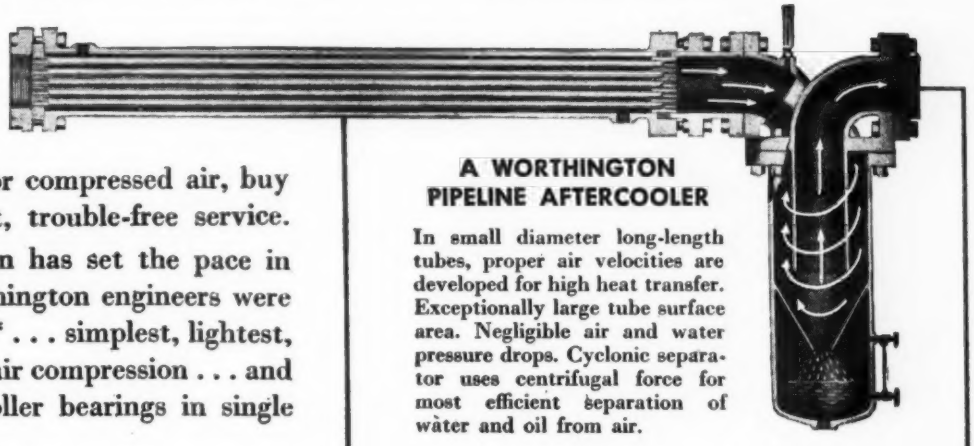
New York Philadelphia Pittsburgh Tulsa Toledo Chicago Atlanta St. Louis San Francisco Los Angeles Houston

Mason Regulator Co. of Canada, Ltd., Montreal, Canada



Compressor BY WORTHINGTON

For Dependable Air at Lowest Cost



A WORTHINGTON PIPELINE AFTERCOOLER

In small diameter long-length tubes, proper air velocities are developed for high heat transfer. Exceptionally large tube surface area. Negligible air and water pressure drops. Cyclonic separator uses centrifugal force for most efficient separation of water and oil from air.

No other compressor will outperform a Worthington

Whatever your need for compressed air, buy Worthington for efficient, trouble-free service.

For years, Worthington has set the pace in compressor design. Worthington engineers were *first* with Feather Valves* . . . simplest, lightest, most effective valves for air compression . . . and *first* with anti-friction roller bearings in single horizontal compressors.

In many cases, in all kinds of manufacturing plants from coast to coast, the type "HB" Worthington Air Compressor shown above has been in operation, without major adjustments, for more than a quarter of a century.

Write for complete data—installation photos—in Bulletin L-640-B1. AC 4-6

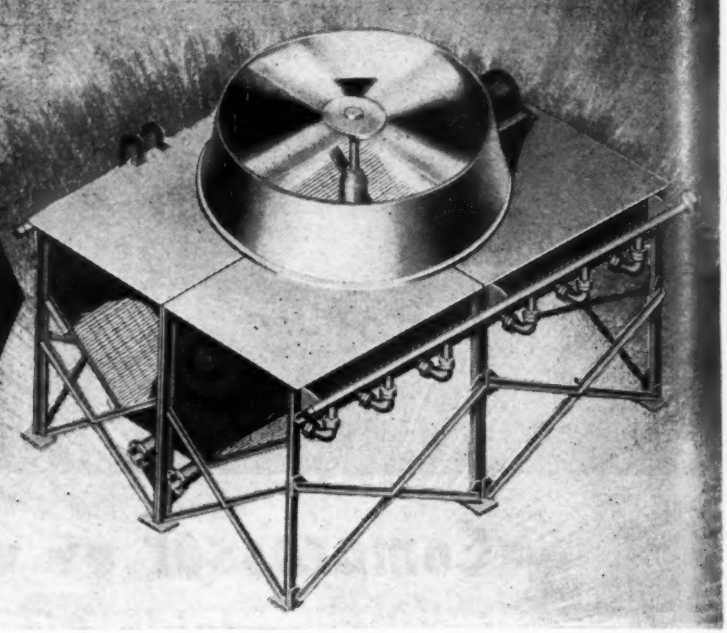
* Reg. U. S. Pat. Off.

WORTH BEHIND THE NAME
WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J., U. S. A.

Efficient Cooling Without Water—

THE NEW ALCO AIR-COOLED HEAT EXCHANGER WILL DO THE JOB BETTER



Here's why:

1. Works at high air temperatures—reliable at all seasons of the year.
2. Extended-finned heat-transfer surfaces.
3. Uniform air distribution by induced draft—high-velocity, vertical discharge prevents recycling of hot air.
4. Because of design, efficiency is not affected by change of wind direction.
5. Not affected by high humidity.
6. Design and construction make field assembly and erection easy and quick.
7. Sturdy steel construction—ample safety factor against high winds.
8. Minimum operating and maintenance expense.
9. Engineered for your specific application from a selection and combination of four standard sizes and five standard coil or core designs for each frame size.
10. In restricted areas the equipment can be mounted on top of existing structures.
11. Recommendations for equipment supplied may be based on a special survey of conditions peculiar to your application by experienced ALCO thermal engineers.
12. Designed, built, sold, guaranteed and serviced by ALCO—with more than 20 years of experience in thermal engineering.

Typical Applications:

1. Jacket water for Diesel and gas engines.
2. Lubricating oil cooling—cools crank case oil in Diesel and gas engines.
3. Cooling gears in large gear boxes, speed reducers, etc.
4. Steam condensing—steam engine, process steam.
5. Gas cooling and vapor condensing—chemical plants, petroleum refineries, etc.
6. Heat-treating metals—cooling bath.
7. The standard air cooled exchanger can be arranged to perform several services simultaneously—such as cooling lube oil, jacket water and gas.

Practical Problems this ALCO Equipment overcomes include:

1. Insufficient water supply.
2. Scale from bad or brackish water.
3. Elimination of expensive water treatment.
4. Waste water disposal difficulty.
5. High-cost water and pumping.
6. High relative humidity.
7. Limited installation space.

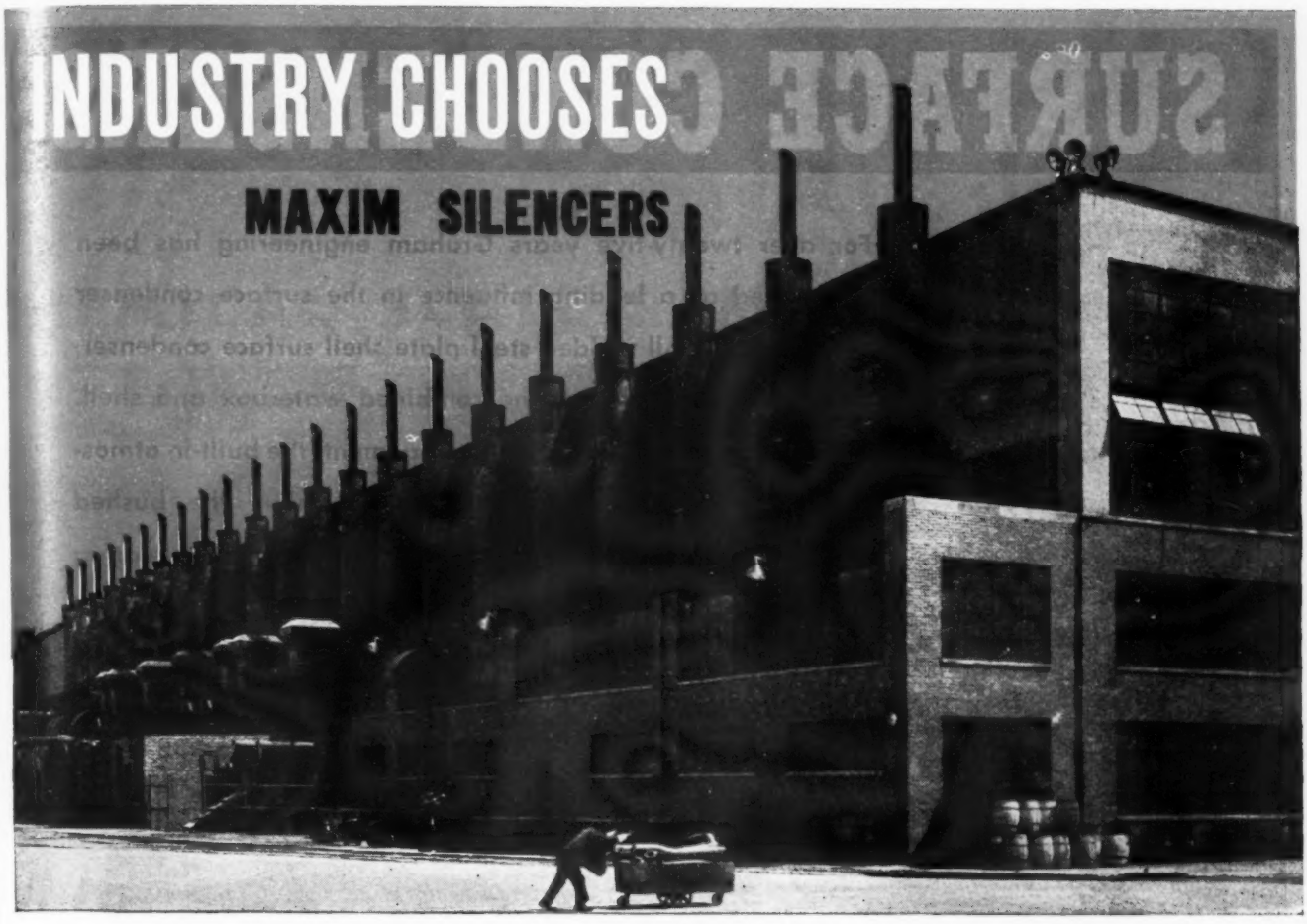
Write for new ALCO bulletin No. 1035

This equipment is fully described and illustrated in a new ALCO Bulletin, now ready. Contains standard specifications. Copy sent promptly on request. Write for your copy now.

American Locomotive

ALCO PRODUCTS DIVISION

30 Church Street, New York 8, N. Y.
Dunkirk, N. Y.



FOR THREE PRACTICAL REASONS

- **EXPERIENCE**

  Maxim, conservatively the greatest name in silencing, has become so because of many years of research and practical experience in this field. Today's Maxim Silencers give users the advantage of this greater experience in development and manufacture of silencing equipment.

- **PERFORMANCE**

  Thousands of installations in many branches of industry give adequate proof of Maxim performance. With many types to select from, the right silencer for the specific installation is carefully chosen and, if necessary, special equipment is designed so that superior performance is assured.

- **ADAPTABILITY**

  Maxim Silencers cover a line so varied that it is seldom necessary to go beyond the standard silencers to get a job "tailor-made" for your installation. No silencer, however good, can do the best job unless it is totally adapted to your particular installation. The flexibility of Maxim's standard silencers line is an important advantage to the buyer.

INDUSTRY CAN SAVE FUEL

WITH MAXIM HEAT RECOVERY SILENCERS . . . . . .

Maxim Heat Recovery Silencers make use of engine exhaust heat, normally wasted, to produce steam or hot water for heating or processing operations. This is done without the use of any *extra* fuel except that normally used in engine operation. Send for Maxim Heat Recovery Silencer Bulletins WH-100, WH-101, WH-102, WH-103.

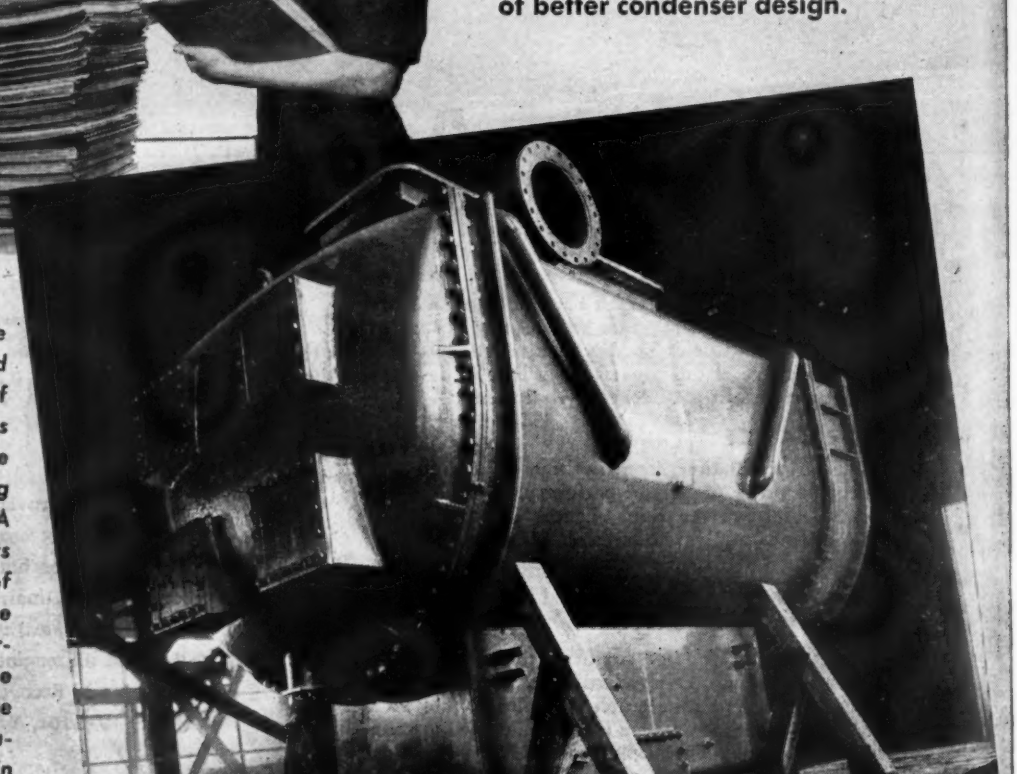
ARMY E NAVY

THE MAXIM SILENCER COMPANY
92 HOMESTEAD AVENUE • HARTFORD, CONN.

MAXIM

SURFACE CONDENSERS

For over twenty-five years Graham engineering has been recognized as a leading influence in the surface condenser field. The first all welded steel plate shell surface condenser, the integral tube sheet, the combined waterbox and shell, the improved twin bank tube arrangement, the built-in atmospheric relief valve, the bushed support plate, *positive reheating above steam temperature;* these are only some of the important Graham contributions to the art of better condenser design.



Shown above are some of the several hundred trial run reports of Uncle Sam's ships on which complete Graham Condensing Plants are installed. A survey of these reports shows an average of 6 degrees of positive reheating, by comparison of Main Turbine Exhaust Temperature and Discharge Temperature from Main Condensate Pumps.

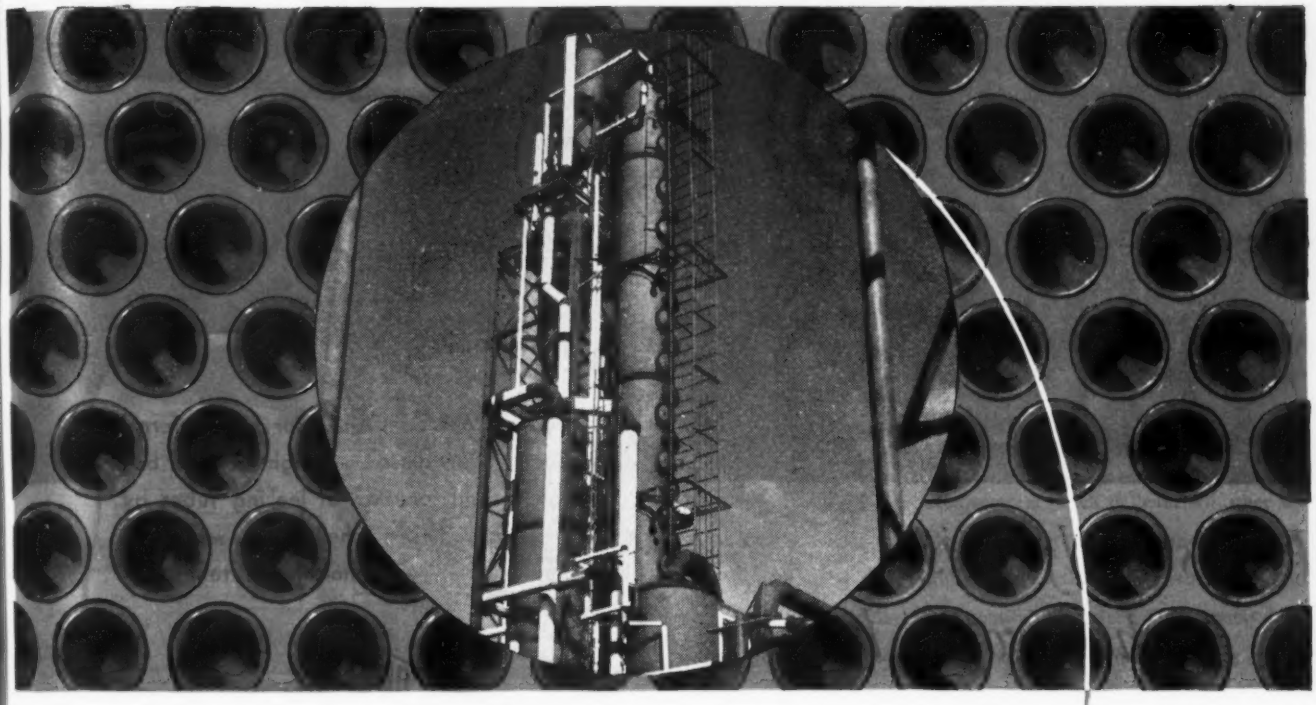
AWARDED THE MARITIME "M" PENNANT AND VICTORY FLEET FLAG APRIL 8, 1944

GRAHAM MANUFACTURING CO., INC.

415 LEXINGTON AVENUE • NEW YORK 17, N. Y.

DOWELL

CHEMICAL SCALE REMOVAL SERVICE



RESTORES OPERATING EFFICIENCY

Dowell Chemical Scale Removal Service is widely used in all industries because it restores heat transfer efficiency and reduces operating costs.

Safe, economical, rapid—Dowell Chemical Scale Removal Service requires no extensive dismantling of equipment and reduces down-time to a minimum.

Thorough knowledge of the composition of the scale deposit, metals and working temperatures dictates the selection of the proper inhibited solvent, addition agents and treating techniques—all necessary to complete removal of the deposit.

Mobile equipment and trained engineers are available at many strategic points. Call the nearest Dowell office for information and service.

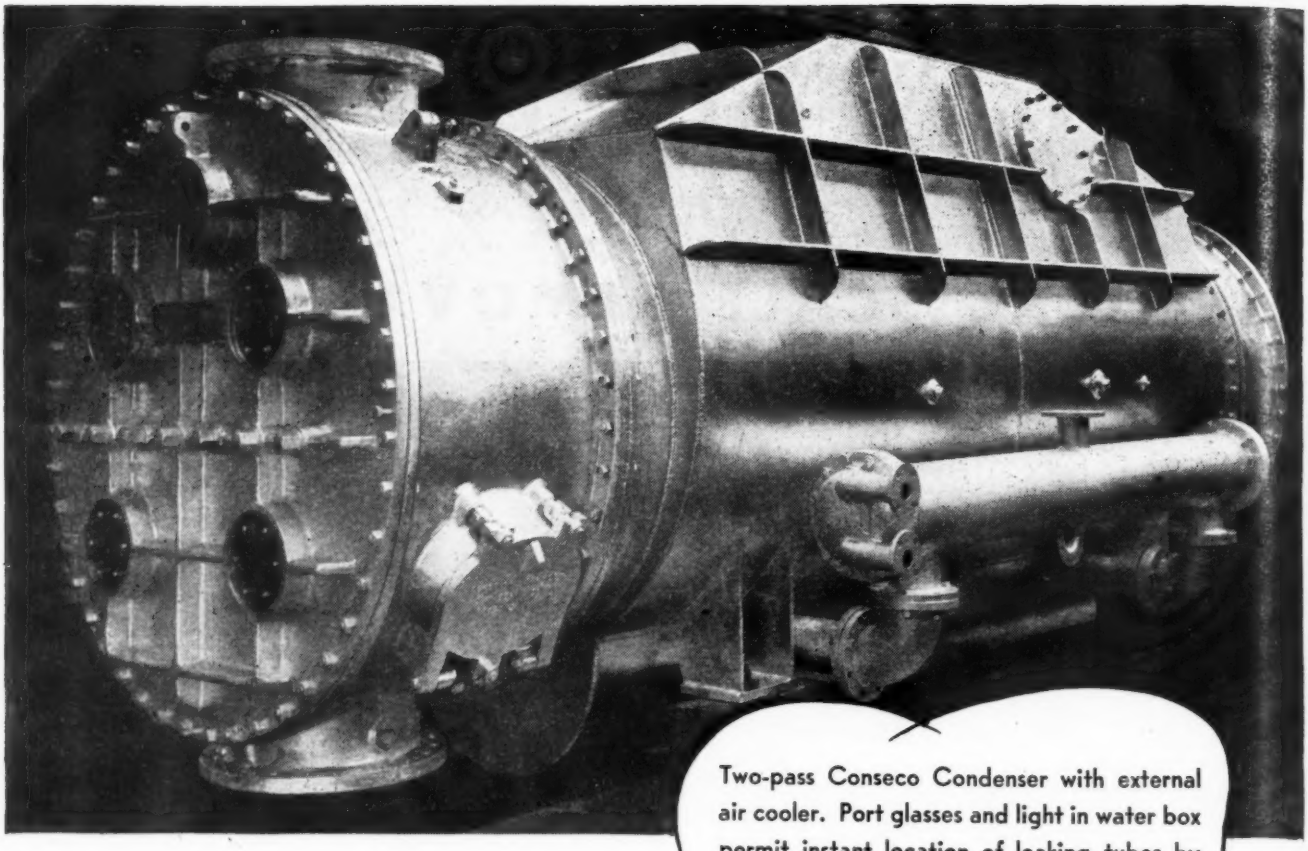
FOR CHEMICAL SCALE REMOVAL SERVICE

DOWELL INCORPORATED

Tulsa 3, Oklahoma

Subsidiary of The Dow Chemical Company

New York • Philadelphia • Cleveland • Chicago • St. Louis • Houston
Kansas City • Wichita • Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, California • Casper, Wyoming



Two-pass Conseco Condenser with external air cooler. Port glasses and light in water box permit instant location of leaking tubes by connecting air hose to shell. Deep water box and quick-opening manhole facilitate internal cleaning.

CONSECO

He is truly wise who profits by another's mishaps

Our broad experience servicing, repairing, rebuilding and replacing thousands of foreign and domestic condensers of all makes, gives us a practical background for designing efficient, economical condensers for any requirement. Every detail in a Conseco Condenser is designed to profit from good and bad features uncovered in the crucible of actual service.

There is no wasteful designing in Conseco Condensers. Materials selected for each part are the most economical for the expected life of the unit in the service for which it is designed.

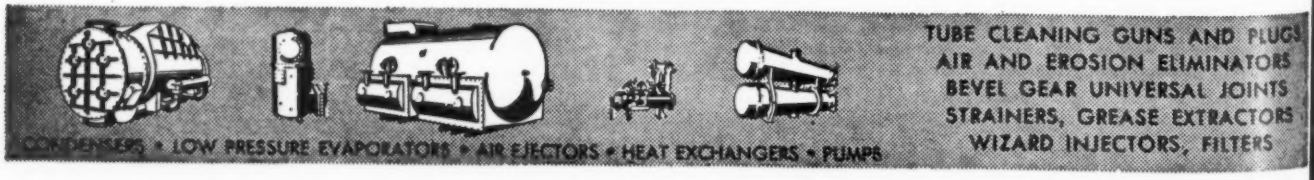
Our engineers will gladly give you the benefit of their extensive experience in the production of an efficient, economical, trouble-free condenser for your particular requirement. And, if you are in a hurry, name your own delivery date.

SERVICE

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

CONDENSER SERVICE & ENGINEERING CO., INC.

81 RIVER ST., HOBOKEN, N. J. Phone—HOboken 3-4425 After 6 P.M. or Sundays—HOboken 3-4428

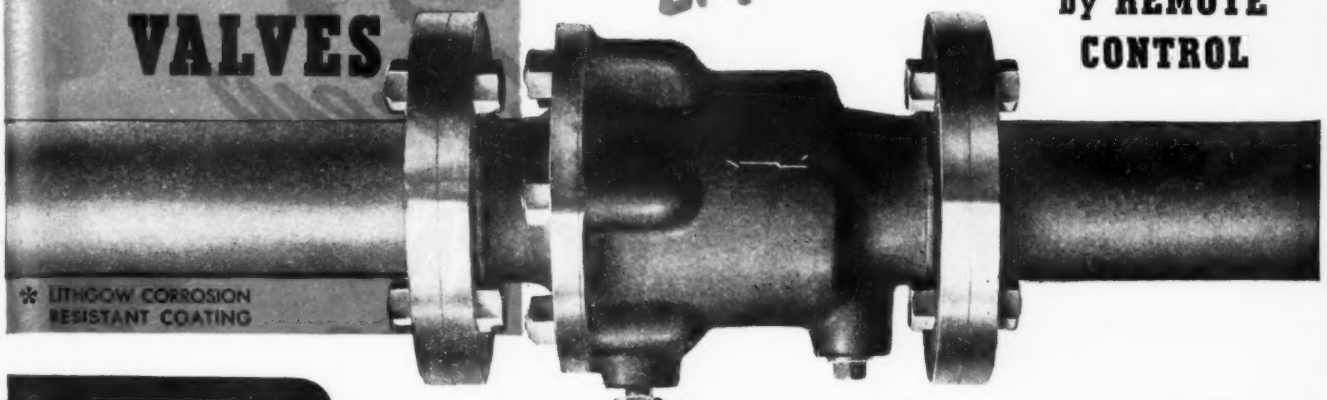


CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

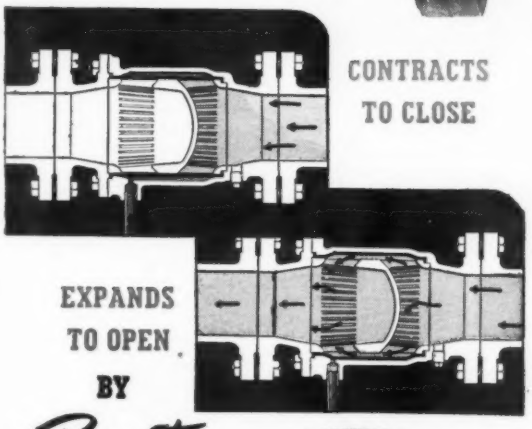
TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

GROVE INNER-CORTED* FLEX-FLO VALVES

HANDLE CORROSIVE LIQUIDS AND GASES by REMOTE CONTROL



* LITHGOW CORROSION RESISTANT COATING



CONTRACTS TO CLOSE

EXPANDS TO OPEN BY *Remote Control*

THE ORIGINAL EXPANSIBLE TUBE TYPE VALVE

Grove FlexFlo Valves employ just one (non-metallic) moving part—a flexible synthetic rubber tube which expands to open and contracts to close. Therefore, there are no rubbing surfaces—no seats, discs, stuffing boxes, etc., to wear, stick or leak. All inner surfaces of the valve are completely protected with resilient Lithgow synthetic coating which impregnably resists highly corrosive fluids and gases, and eliminates any possibility of electrolytic action. Line fluid is hermetically sealed off from the external operating medium by the flanged lips of the cylindrical expansible tube which is securely anchored within the valve body. External remote control operation of the FlexFlo Valve may be affected manually, automatically or in combination with automatic control instruments.

Write for Bulletin 800 Today.

UTILIZE *ANY* EXTERNAL SOURCE OF FLUID PRESSURE SUPPLY

GROVE FLEX-FLO REMOTE CONTROL VALVES

GROVE
SIMPLICITY
ACCURACY
SAFETY

GROVE REGULATOR COMPANY

6547 GREEN STREET, OAKLAND 8, CALIFORNIA. *Branch Offices:* 30 Rockefeller Plaza, New York 20 • 5644 Navigation Boulevard, Houston 11, Texas • 1930 West Olympic Boulevard, Los Angeles 6, California

WRITE TODAY FOR BULLETIN 800

RUST—a nuisance and a very costly menace in many plants no longer need be tolerated. Laboratory magic has furnished its master.

New Sinclair products, developed to solve tremendous military rust problems, are now available for your plant problem.

Sinclair RUST-O-LENE B for exposed metal surfaces of machinery in operation, in storage, or in transit

—provides a firmly-adhering rust proofing film
—prevents rusting of clean surfaces
—halts further rusting of corroded surfaces
—has lubricating qualities
—defies any degree of moisture from mere dampness to heavy rain
—can be readily removed when desired

Sinclair OPALINE RP (Rust Preventing) OILS for enclosed oil systems, prevent internal rusting of engines, hydraulic systems, gear reducers, and similar machinery intermittently operated, stored, or transported. OPALINE RP also has ample lubricating qualities for temporary use.

Both these remarkable Sinclair rust-preventives have successfully passed the most exacting service tests, and fully meet Government specifications.

Learn how RUST-O-LENE B and OPALINE RP can combat rust for you. Write for brochure giving full details.

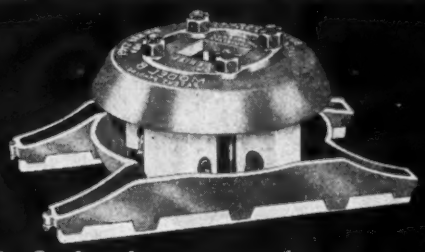
SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

Non Chemical

BOILER WATER TREATMENT

Is Keeping Thousands of Boilers Free of Scale and Corrosion



De-Scalers have no moving parts, and require no adjusting

FROM A PROMINENT USER

June 28, 1944

Butler Engineering Co.,
926 Magazine Street,
New Orleans 11, La.

Gentlemen:

We have seven water tube boilers ranging in sizes of-150, 250, 460, and 1060 rated horsepower operating during peak loads that are over 200% of rating and all the boilers are equipped with Butler De-Scalers. These De-Scalers were first installed in May of 1943. Tests were run and periodical inspections made with the result that we are now using the De-Scalers exclusively.

The city water in this locality is hard and contains a high percentage of solids. We use the Permitit Zeolite Water Softener to rectify this condition somewhat.

We have not used the tube turbine since the installation, in fact what scale was on, had peeled off.

Continuous blow down is made use of on all boilers, these were installed as directed by Butler Engineering.

We feel that the De-Scalers are doing a job for us. You ask what difficulties we had prior to our installation of De-Scalers. This question may best be answered in dollars and cents.

Using chemical treatment, we had to change the dosage to comply with laboratory recommendations; we had to depend upon the human element; to execute the order, the boiler blow down was directed by the chemical laboratory. Sometimes it would take 3 weeks to turbine the tubes and scrape the drums. We kept close of these costs; as for chemicals with all its inconvenience it cost $3.50 per day per boiler. With De-Scalers it cost $.87 per day per boiler minus the human element and the unnecessary waste of heat through the blow downs.

We took a battery of 3 De-Scalers out of our #2-460 HP boiler this past week after 6 months of hard service. The cartridge showed very little errosion and are good for more than 12 months of additional service.

HENRY HEIDE INCORPORATED
Established 1869

Quality Candies
Bakery Products

SPRING, HUDSON & VAN DAM STREETS
NEW YORK, N Y

May 24, 1944

Mr. Frank Spillane
c/o William McDonagh & Sons
180 Front Street
New York, New York

Dear Sir:

We have installed Butler De-Scalers in 8 of our 400 H.P. Babcock and Wilcox water tube boilers; and I am pleased to inform you, that we are very much satisfied with the results obtained from the Butler De-Scalers.

Yours very truly,
HENRY HEIDE, INCORPORATED
John Hofmann
John Hofmann
Chief Engineer

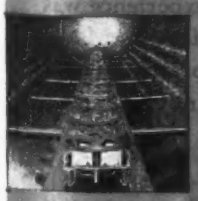
JH:blv

BUTLER DE-SCALERS*

De-Scalers provide a more satisfactory water correction, as their performance is predicated on a simple basic principle. The wide-spread preference for this non-chemical and reliable water treatment results in part from the De-Scaler's years of performance in thousands of boilers throughout the world. De-Scalers furnish the most modern and economical water correction obtainable. Not alone does the De-Scaler keep all inside surfaces of the boiler clean, but protects the entire piping system against corrosion.

De-Scalers have been developed to operate in boilers up to 350 psi.

This Protection Saves Boilers



SCALE

The submerged De-Scaler by its self-induced action precipitates the scale-forming salts contained in the boiler water, preventing the formation of new scale. This action gradually removes all old scale, regardless of its thickness or type.

PITTING

The low current generated by the De-Scaler is greater than the current generated in the boiler, and overcomes lesser electrolytic effects of other metals in the boiler. Such pitting action takes place on the Butlermetal Cartridges, which disintegrates.

CORROSION

The Butlermetal cartridges have a far greater affinity for dissolved oxygen than any metal in the boiler, and thus bear the brunt of the corrosive attack.

**Patented; other patents pending. Trade-mark Reg. U. S. Patent Office.*

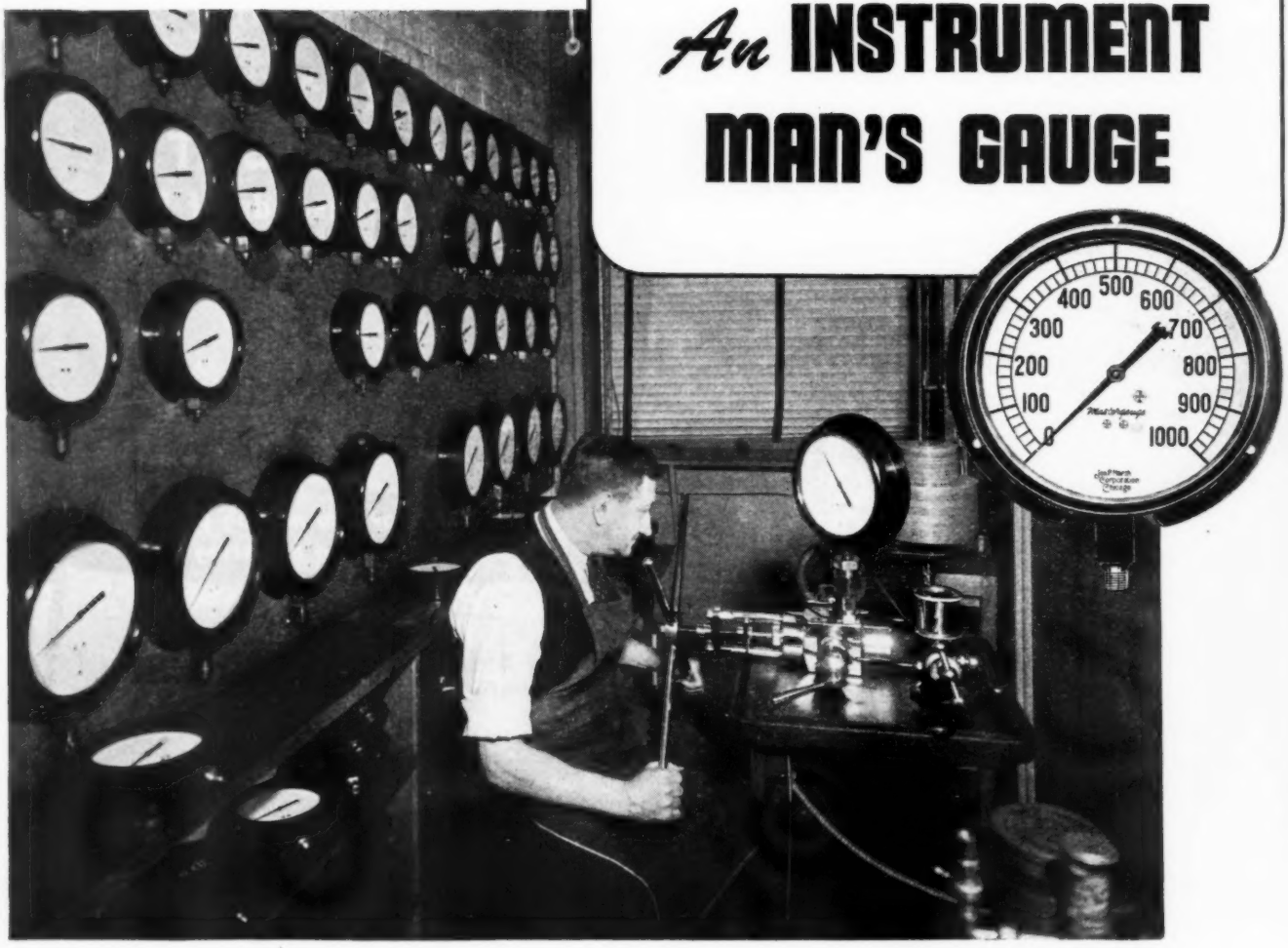
DE-SCALER PERFORMANCE IN THE BOILERS

- No water analysis necessary.
- Stops scale formation.
- Causes the removal of old scale.
- Stops foaming and priming.
- Prevents electrolytic and oxygen corrosion.
- Will not harden soft packing.
- Will not corrode metalic packing.
- Eliminates hand scaling, tube turbining.
- Will maintain a proper PH value.
- No long boiler shut down for cleaning.
- No chemicals or Boiler Compound.

SEND FOR BOOKLET
"Presenting Butler De-Scaler"

BUTLER ENGINEERING CO., 926 MAGAZINE STREET, NEW ORLEANS 11, LA., U.S.A.
Distributors with Stocks and Service in Important Industrial Centers throughout the United States.
Export Representatives: WM. McDONAGH & SONS, 180 FRONT STREET, NEW YORK 7, N. Y. U. S. A.
Canadian Representatives: JOHNS MACHINE AND TOOL COMPANY, 484 McGILL STREET, MONTREAL 1, CANADA

An INSTRUMENT MAN'S GAUGE



The gauge with the "RECALIBRATOR"

A gauge built to Marsh standards is not likely to be knocked out of adjustment. But if it is, the Marsh "Recalibrator" will quickly restore its accuracy. Simply turn the "Recalibrator" screw until the pointer coincides with zero. The gauge will then be right at all points on the dial. Unlike other methods of re-setting, the "Recalibrator" re-establishes the proper relation of the bourdon tube to the movement—actually *re-calibrates* the gauge. The conventional method of removing and re-setting the pointer does not accomplish this.

• In many large organizations there are men who have lived with pressure gauges until they know every good trait and bad habit of every make of gauge under the sun.

Marsh Gauges were designed for such men . . . or perhaps it would be more accurate to say that they were designed *by* them. Their experience was consulted—the characteristics they wanted were incorporated in Marsh design and construction. That is why the Marsh Gauge—particularly as exemplified in the Mastergauge—can truthfully be called "an instrument-man's gauge".

It probably isn't necessary to go beyond your own organization to confirm this. But if it is, you can find eloquent proof that the Marsh gets the full vote of those who know gauges best in its widespread standardization as original equipment by the most discriminating manufacturers of products requiring pressure indication.

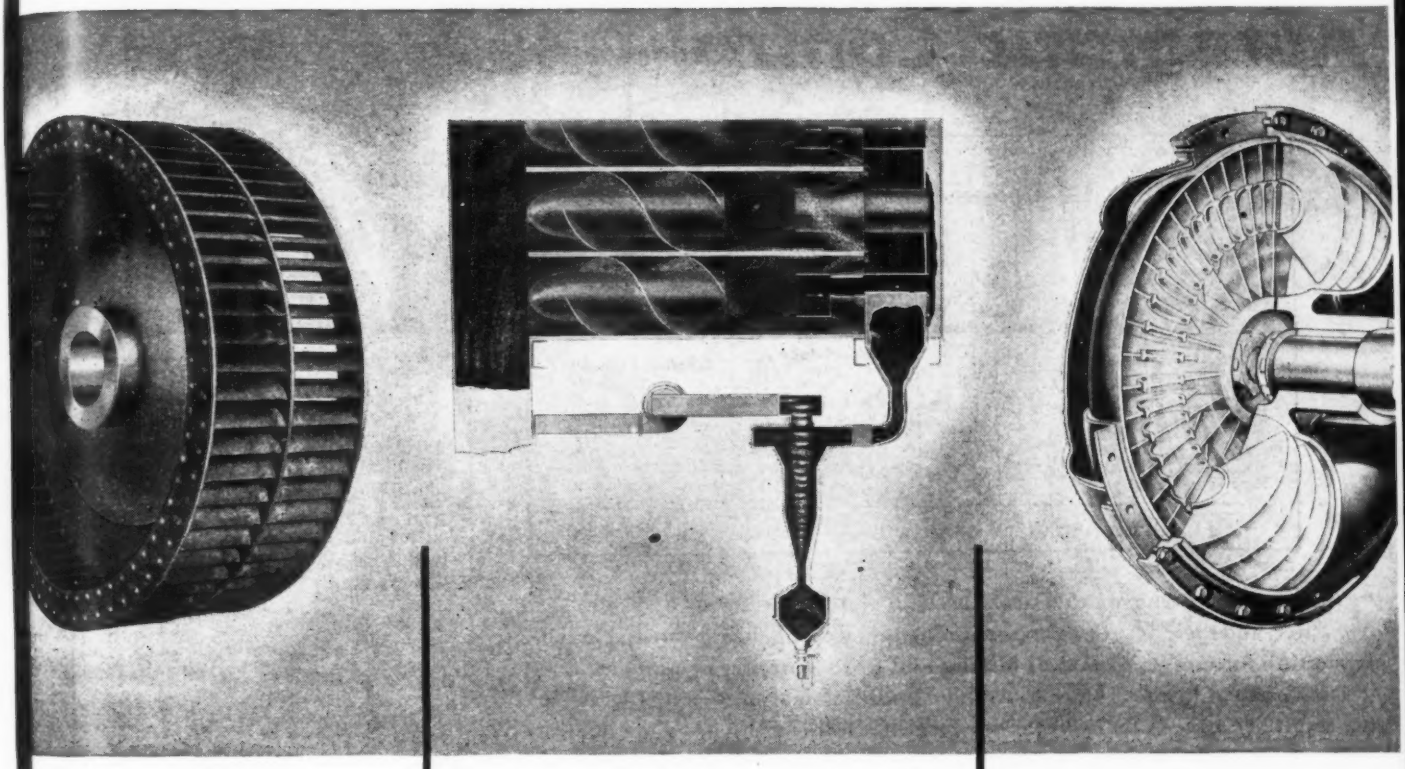
JAS. P. MARSH CORPORATION, 2075 Southport Avenue, Chicago 14, Illinois
Export Department: 155 East 44th St., New York 17, N. Y.

MARSH GAUGES

"THE STANDARD OF ACCURACY"

DIAL THERMOMETERS HEATING SPECIALTIES

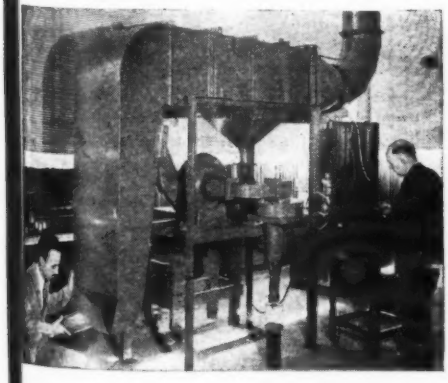
One man sells ALL THREE!



1 American Blower Forced and Induced Draft Fans are widely known for outstanding performing qualities and dependable operation. Many power plant executives say they would not have any other make. Those who want undivided responsibility do not stop with American Blower Fans but take Step 2.

2 American Blower Type ST Dust Precipitator does away with the fly ash nuisance. No water required — no complicated electrical equipment to clean. Far-sighted power plant engineers have found it has another distinct advantage — it definitely reduces fan maintenance. And, speaking of fans, control and fans go together. That's why we remind you of Step 3.

3 Fluid Drive has proved so successful for variable speed fan control, we needn't go into details. Suffice to say, leading power producers tell us Fluid Drive increases overall plant efficiency . . . Best part of it is, one man sells all three. Saves your time, provides undivided responsibility, greater satisfaction!



HOW TO SOLVE YOUR DUST OR FLY ASH PROBLEMS

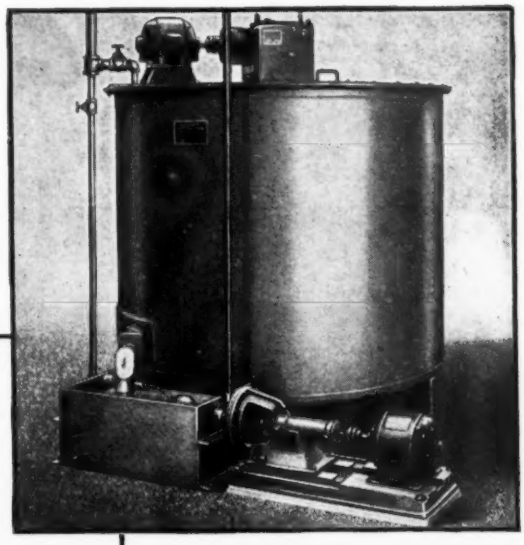
The photograph, on left, shows a part of our modern Dust Testing Laboratory. Here, special laboratory collectors determine the design necessary to meet any specific problem. In the last 20 years, we have run tests on more than 4100 distinctly different materials. These tests include microscopic investigations, screen analyses, and collector performance. American Blower not only has the finest facilities for testing, but we also have the largest facilities for building Dust Precipitators. Every Dust Precipitator we sell is built entirely in our own plants. Why not take your problem to the oldest and largest manufacturers of this type of equipment in the world?

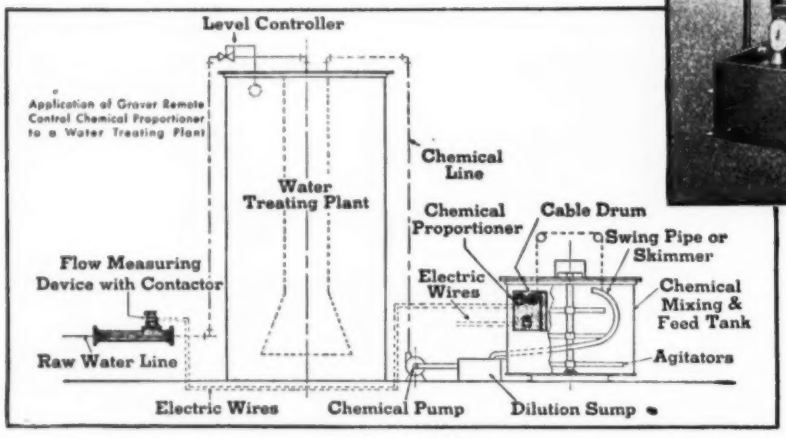
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

GRAVER Chemical Mixers and Proportioners Insure Accurate, Automatic Control





This diagram shows the arrangement of agitators and baffles and the method of lowering the swingpipe into the chemical solution by means of a cable attached to the Graver Proportioner. The chemicals discharged from the swingpipe are diluted with softened water before they are picked up by the chemical pump.

THE proper mixing of chemicals used in the conditioning of boiler feed water, and their accurate proportioning and feeding, have won an enviable reputation for Graver Chemical Mixing and Proportioning Equipment.

The Graver Chemical Mixing Tank embodies numerous features which are the result of Graver's many years of experience in the design and manufacture of water conditioning equipment of all types. A unique arrangement of agitators and baffles insures uniform distribution of soluble and insoluble chemicals, providing a non-swirling mix free from stratification of chemicals.

The Graver Remote Control Proportioner provides several distinct advantages. It can be used with any standard flow meter and the meter can be located at any desired point in the raw water supply line. It has an accuracy of 98% at all flow rates and automatically permits instant increase or decrease of the chemical charge over a wide range, should a change of treatment be required.

The flow measuring device is fitted with an electric contactor designed to make contact for a predetermined amount of water passing through the meter. The impulse is transmitted to the Proportioner, setting it in motion instantly. If the electric current fails, the Proportioner may be operated manually.

Graver designs, builds, and installs water conditioning equipment of all types to meet every requirement. Whatever your problem may be, our engineers will gladly consult with you.

The Graver Remote Control Proportioner is a compact unit which can be conveniently mounted near the chemical mixing tank. The variable type timer is designed to operate the motor drive of the proportioner for a predetermined length of time for each impulse received from the meter contactor. Should a change of treatment be necessary, the variator can be adjusted, permitting the operator to vary the amount of chemical feed, plus or minus 50%. This equipment is adaptable to any make of solution type chemical feeder where a swingpipe or skimmer can be installed.

GRAVER MIXING EQUIPMENT

Process Equipment Division of

GRAVER TANK & MFG. CO., INC.

4809-25 Tod Ave., East Chicago, Ind.

NEW YORK CATASAUQUA, PA. CHICAGO TULSA

Hot Process Water Softeners—Zeolite Water Softeners—Water Filters—Oil Removal Filters—Iron Removal Filters—Taste and Odor Removal Filters—Reactivators—Filtering Materials—Zeolites

THE name Sivyer has long meant quality steel castings—castings meeting *and exceeding* all the requirements for high pressure, high temperature service . . . for long-time service.

Behind these castings stands Sivyer's third of a century experience—assuring close dimensional accuracy, trueness to pattern contour and shape and integrity of metal. It is these all-important qualities that have established the Sivyer trademark Ⓢ as worth looking for when longer casting life is wanted. Make Sivyer *your* source for all steel castings.

SIVYER STEEL CASTING COMPANY

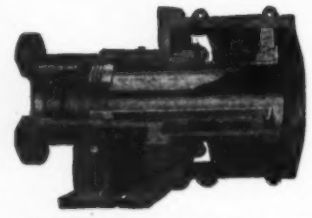
MILWAUKEE Ⓢ CHICAGO Ⓢ

ARMY E NAVY

TODAY *and* POSTWAR

ADSCO

OFFERS OVER 65 YEARS OF "KNOWING HOW" *in the* DESIGN *and* CONTROLLED PRODUCTION *of* STEAM LINE EQUIPMENT



PISTON RING EXPANSION JOINT

INTERNALLY GUIDED JOINT

ADSCO-BANNON TILE CONDUIT

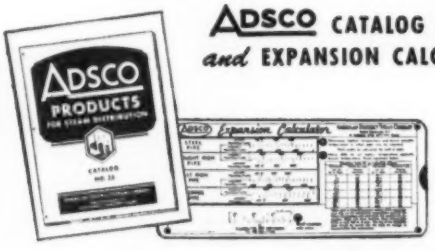
CONDENSATION METERS

ADSCO HEAT EXCHANGERS

FLOW METERS

Over 65 years of "knowing how" are reflected in the design of every ADSCO product. Every step in their production through foundry, welding and machining operations to the final assembly is closely controlled and supervised by ADSCO trained experts. This rigid conformity to high standards and latest code requirements is your best assurance of built-to-last steam distribution equipment from a single source of supply for district or central heating systems.

All ADSCO products are described in the latest Catalog No. 35 which will be sent upon request to any engineer who specifies, requisitions or purchases steam distribution equipment — with the catalog we will include the handy ADSCO Expansion Calculator, a simple slide rule for quickly determining the expansion of pipe due to temperature changes. Write for your copy of the ADSCO Catalog TODAY.



ADSCO CATALOG NO. 35 *and* **EXPANSION CALCULATOR**

ADSCO PRODUCTS INCLUDE

- Expansion Joints
- Tile Conduit for Underground Pipe Lines
- Pipe Supports
- Saddle Plates
- Alignment Guides
- Steam Traps
- Steam Separators
- T and Y Type Strainers
- Storage Water Heaters
- Instantaneous Heaters
- Heat Economizers
- Fuel Oil Heaters
- Special Heat Exchangers
- Jacket Water Coolers
- Condensation Meters
- Flow Meters for steam, water, gas or air

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, NEW YORK
Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

Here's convincing proof of service life

with

CHASE ANTIMONIAL ADMIRALTY*

During the past nine years, *millions* of pounds of Chase Antimonial Admiralty have been installed . . . yet not one service failure from dezincification has been reported to mar the performance record of this condenser tube alloy. And here's another thing: while the antimony greatly reduces the yearly costs of your condenser tubes (due to the increased resistance to dezincification), the initial tube cost is no more than for plain Admiralty.

If you are seeking a reliable, economical condenser tube for salt or brackish cooling water conditions, you need look no farther than the *proved* performance record of Chase Antimonial Admiralty.

KEEP THIS IN MIND — Chase Antimonial Admiralty offers you outstanding service life because it is (1) highly resistant to dezincification; (2) virtually immune to stress-free intercrystalline corrosion; (3) costs no more than plain Admiralty.

For details phone your nearest Chase Warehouse or Service Office.

*U. S. Pat. No. 2,061,931

CHASE

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY at HOUSTON LOS ANGELES NEW ORLEANS SAN FRANCISCO TULSA

CHASE BRASS & COPPER CO.

—Incorporated—
Waterbury, Connecticut
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO
CINCINNATI CLEVELAND DETROIT HOUSTON
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MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK
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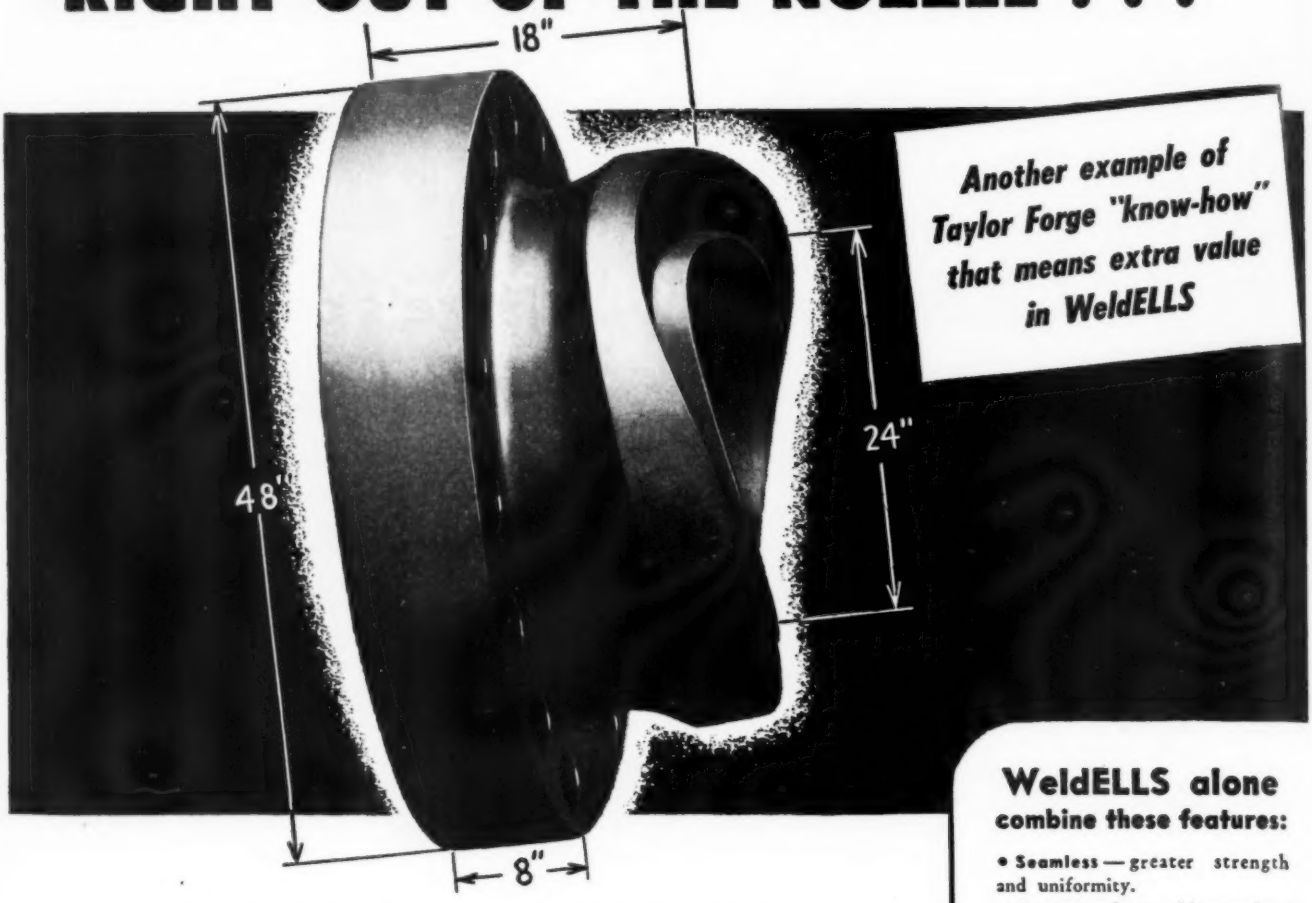
† *Indicates Sales Office Only*

This is the Chase Network—handiest way to buy brass

RIGHT OUT OF THE NOZZLE . . .



Another example of Taylor Forge "know-how" that means extra value in WeldELLS

★ *Walk into any big, modern oil refinery or power plant and the chances are you will find Taylor Forge nozzles like the one pictured above providing safe, full strength outlets on high pressure boilers and pressure vessels. This is no coincidence. As America's first maker of fully reinforced pressure vessel outlets, Taylor Forge has built up a fund of technical information on the complicated subject of stress conditions in such vessels, and engineers have learned to draw heavily upon our experience and knowledge in designing for full strength.*

NOZZLES like the above bring the steam or other fluid out of the boiler or pressure vessel, but from there on the job is taken over by the piping system. And here, too, Taylor Forge "know-how" and experience play an important part. For this knowledge has resulted in a very nearly ideal line of Welding Fittings.

Yes, WeldELLS and other Taylor Forge Welding Fittings are *designed* for the job they are to do . . . designed to provide safe, long lived and economical piping.

Just take a moment, please, and check the list of features opposite. Are there any you would omit? Can you think of any you would add?

That's why we say WeldELLS are very nearly ideal—why you can be sure that

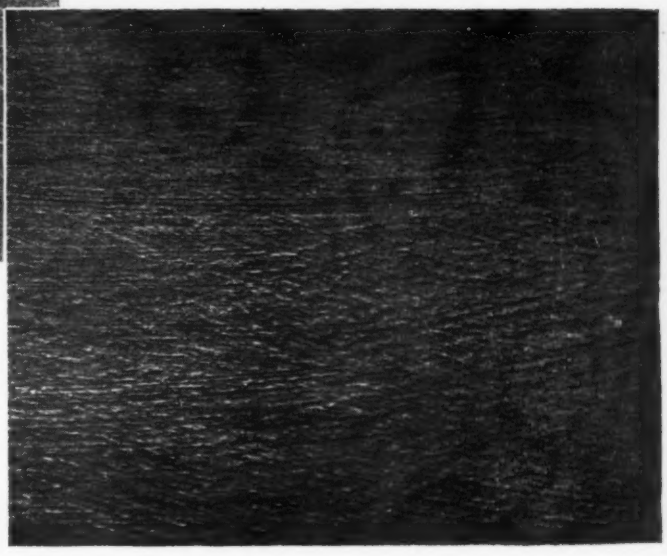
WeldELLS have everything

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

This May Be Extreme, But It May Happen Within A Short Time In Any Boiler



This Apexiorized Metal Has Not Been Affected By Boiler Water During the Past 15 Years

That smooth, brush-marked surface is APEXIORIZED metal. The thin, but tough, durable APEXIOR coating has added years of life to the metal.

APEXIOR keeps metal young by providing an effective and long-lasting barrier against water and corrosion. It retards scale formation, lengthening the periods between cleaning and making scale removal easier. Operating efficiency is thus improved and manpower conserved.

Boiler Insurance — Brush-Applied

APEXIOR NUMBER 1 is a water and steam resistant paint, purposely developed to provide a protective coating for steel and iron. It is not affected by high temperatures, high pressures or ratings, by chemical treatment of boiler water or by varying feedwater conditions. It does not retard heat transfer.

The thickness of two coats of APEXIOR NUMBER 1 is only about .0025", yet one application lasts 2 to 3 years or more. It is easily renewed.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many manufacturers of turbines coat their shafts, rotor bodies, and frequently interiors of casings with APEXIOR before shipping to customers.

Let us give you more facts. Use the coupon below. The Dampney Company of America, *Main Office* Hyde Park, Boston, Mass. *Branch Offices*, Atlanta, Chicago, New York, Detroit, Philadelphia. *Engineering Sales Representatives*—Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B.C., Montreal, P. Q., Havana, Cuba, Honolulu, T. H. *Marine Dept.*, 114 Liberty Street, New York, N. Y.

For "Cold-Wet" Metal Surfaces— APEXIOR No. 3

Wherever you have tanks or metal surfaces exposed to water or moisture at any temperature under 125°F.—protect them with APEXIOR NUMBER 3. This special, shiny black paint on metal is highly resistant to cold water, fresh or salt.

Organizations like these have used APEXIOR for years

Aluminum Co. of America
Boston Edison Co.
Lever Bros. Co.
Swift & Co.
Truscon Steel Co.
Goodyear Tire & Rubber Co.
Standard Oil Co. of N.J.
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Delaware Power & Light Co.

APEXIOR

Keeps new metal new . . . Gives old metal new life

The DAMPNEY COMPANY of America
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

Name.....

Company.....

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PACKED WITH SATISFACTION

When You Use R/M

For valves or any other industrial packing job . . . pumps, compressors, steam engines, manholes, etc. . . . R/M packings give long, satisfactory service • Altogether, R/M makes more than 73 different types of packing: Rings, spirals, wicks, coils, sheets, spools, tubes, gaskets, bulk.

. . . each in a wide range of sizes
. . . for temperatures to 1200° F.
. . . for pressures to 5,000 lbs.

This complete, reliable, time-tested line is all one quality and backed by more than forty years' experience with diversified packing problems. Specify R/M for permanent, leak-tight packing.

INDUSTRIAL SALES DIVISION

RAYBESTOS-MANHATTAN, INC.

MANHEIM, PENNSYLVANIA

Bridgeport, Conn. • North Charleston, S. C. • Passaic, N. J.

PACKINGS FOR EVERY INDUSTRIAL USE

CLARAGE
ENGINEERS KNOW HOW

NO INSTALLATION DELAYS — Whole Works In One Compact Assembly!

Clarage Multitherm Units can step up your production, and insure lower post-war costs. Units are made for cooling only, heating only, or complete year 'round air conditioning. Quickly installed without expensive building alterations; no ducts required. Space-saving, suspended type unit shown above.

SPECIAL SERVICES

Back of our field engineers are design specialists, research and testing laboratories. We are geared to solve any air handling or conditioning problem, no matter how special.

Too much or too little heat, too much or too little humidity, smoke, fumes, foul odors — are *BAD* air conditions keeping your production low, costs high — giving your plant an acute absentee problem?

★ Possibly it's time to have a Clarage application engineer give your operations the once-over — have him spot your air handling or conditioning needs. *HE KNOWS HOW!* You'll like his intelligent, forthright answer to your requirements.

★ You'll like, too, the way we at the factory do our part to back him up by furnishing equipment engineered for high efficiency, and built for unfailing service. Our total and unexcelled facilities are at your command!

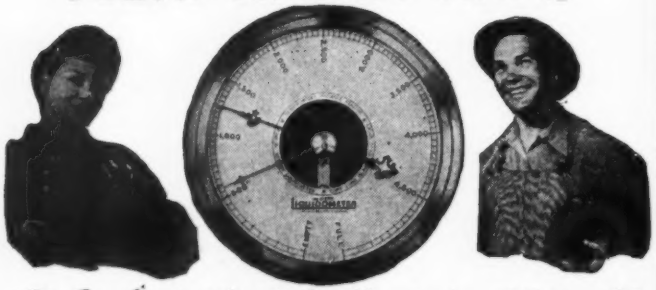
ARMY (E) NAVY

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo 16, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

TODAY OR POST-WAR!



It Is Important to Measure Valuable Stored Liquids Accurately With—

LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.

No pumps, valves, or auxiliary units needed to read them.

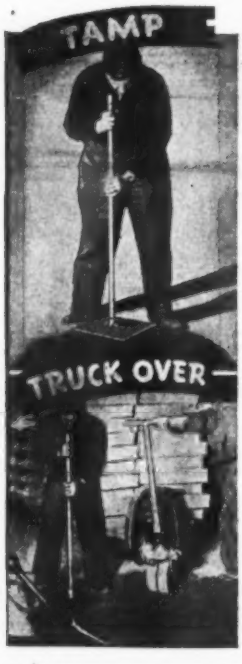
Models for either remote or direct readings.

Accuracy unaffected by specific gravity of tank liquid.

Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details

THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, L.I., N.Y.



How to PATCH FLOORS

...Without Stalling Traffic

Now you can restore broken concrete to solid smoothness without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

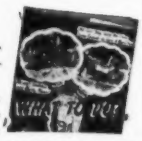
REQUEST DESCRIPTIVE FOLDER And Details of FREE TRIAL OFFER

INSTANT-USE

FLEXROCK COMPANY
3677 Filbert St., Philadelphia 4, Pa.

Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.

Name .....
Company .....
Address .....



Mr. Fillet Weld HELPS KEEP 'EM CLEAN!

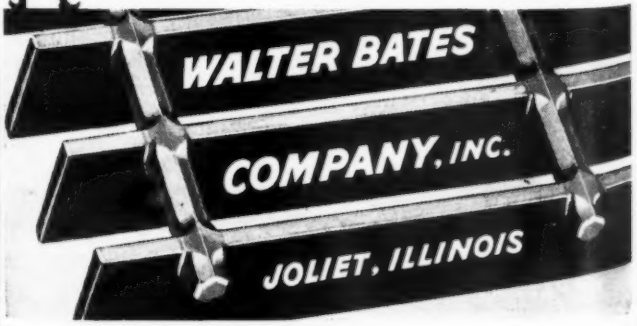
• The presence of Mr. Fillet Weld in **BATES • GRATES** means his pal, the Hex Cross Bar, is there too. This combination provides clean, crisp, SAFE open steel flooring and stair treads. There's nothing better or safer than clean, straight edges of steel—such as the top edges of **BATES** main bars and welded Hex Cross Bars. They're easier to maintain, too.

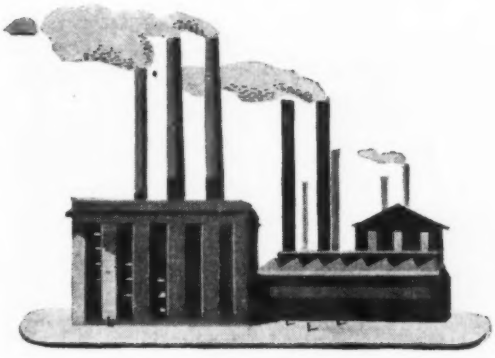
that's only one reason why BATES • GRATES are better

• This safety angle is only one of the distinctive features of **BATES • GRATES**. The Fillet Welded Hex Cross Bars make **BATES** stronger. The design also allows maximum light and ventilation.

All this adds up to:

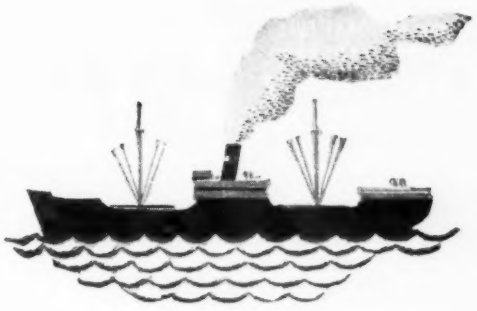
Get a bid from BATES on every job where you need GRATES





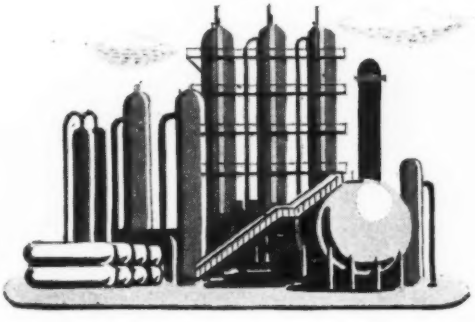
CURED BY A NOSE FOR TROUBLE

Consistent failure . . . at the same definitely-located points . . . led this power plant to apply to Scovill for help. Scovill *Service in Men* helped determine that chlorine leakage was causing the trouble. A few simple installation changes cured the trouble.



DOUBLE RIDE WITH CUPRO-NICKEL

Admiralty tubes operating in 210°F., vapor-side, lasted only 8 months. Contaminated salt to brackish circulating water invited permeable scale formation, favoring dezincification. Scovill *Service in Metals* recommended 70-30 Cupro-Nickel, lengthening service life 100%.



CONCERNING AN INFORMATION EXCHANGER

Many a refinery man, reading Scovill's Condenser Tube Booklet, has widened his knowledge of certain phases of heat exchanger tube service. Scovill *Service in Manuals* reports regularly on studies of Scovill research laboratories plus experiences of Scovill service engineers.

All three types of problems...selection of the proper metal...correct installation practice... desire for further information—are directed to Scovill because it is

One Company Which Gives You

ONE PRODUCT

. . . Condenser Tubes

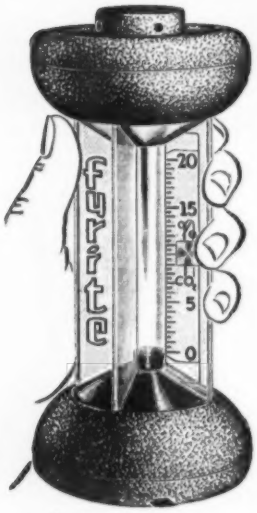
THREE SERVICES

For a free copy of the new Scovill Condenser Tube Booklet, write SCOVILL MANUFACTURING CO., 13 Mill St., Waterbury 91, Conn.

COOPERATE with the NATIONAL FUEL EFFICIENCY PROGRAM **TO SAVE VITAL WAR FUELS**

USE THE **PRACTICAL FYRITE CO_2 INDICATOR**

REVEALS FUEL WASTE *INSTANTLY!*



CO_2 analysis of the flue gases is the only method available for determining the percentage of fuel wasted up the stack. The practical FYRITE CO_2 Indicator makes accurate flue gas tests easy—quickly pointing the way to adjustments and repairs necessary to secure efficient fuel utilization. The FYRITE requires no skill or technical knowledge; is simple and rugged; has no valves, clamps, or leveling bottle, no glass parts or batteries.

OXYGEN INDICATOR designed on same principle available soon. Write for particulars.

$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

RETURN THIS COUPON FOR BULLETIN 341 on FYRITE. *Learn how to get immediate delivery under priority regulations.*

Name

Address

City State

HEATING SERVICE DIVISION
BACHARACH
Industrial Instrument Co.
7000 BENNETT ST.
PITTSBURGH 8, PA.

EVERY BOILER
SHOULD HAVE ITS OWN . . . .
CAT'S-EYES

FOR BETTER COMBUSTION

THE BEST BOILERS ALSO USE

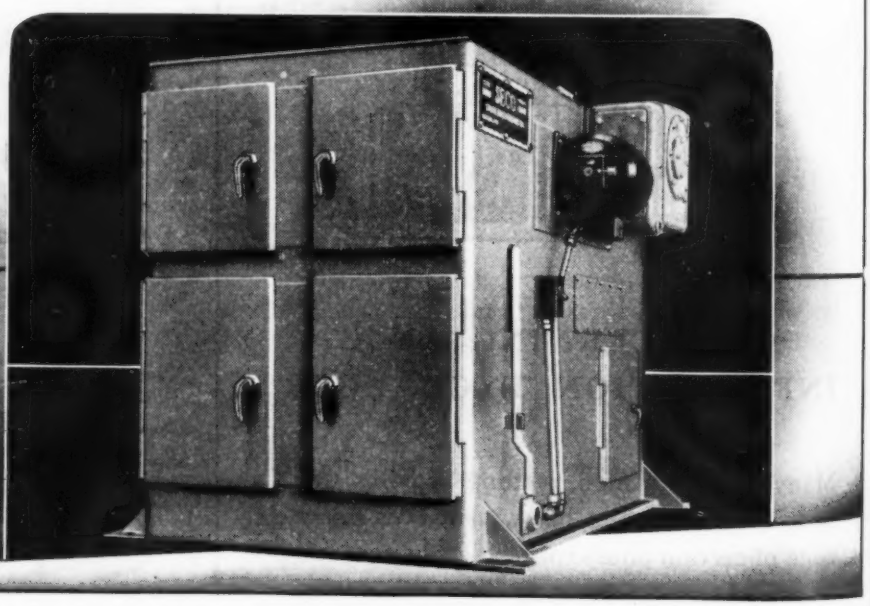
ESS HAZEGAGES or WYD-ANGLE PERISCOPES

ESS INSTRUMENT CO., FORT LEE, N. J.

Indicators, Controllers, and Recorders for Smoke Haze and Combustion . . Specific Gravity . . . Turbidity . . Flame Failure . . . Industrial and Safety Applications

Solution to Coal Dust Control:

***The* S. E. Co. *Dust-tight* Coal Scale!**



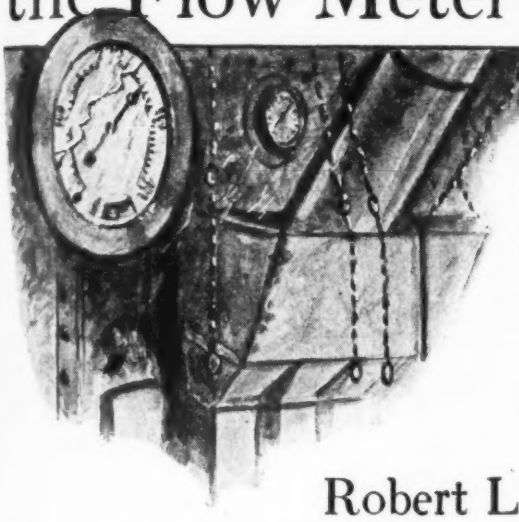
A clean, bright, "eat-off-the-floor" boiler room, free of dust-clogged equipment can't be maintained where coal dust is constantly sifting out on floors and walls. The ruggedly dependable S.E.Co. Coal Scale is built to lick this dust problem for you! Its frame is dust-tight, the beams pivots and loops are enclosed in a dust-proof case and the scale doors are equipped with positive dust seals. Thus, not only the scale, but *all* the equipment in your boiler room is kept dust free for efficient operation.

We'll forward complete information on S.E.Co. Coal Scales at your request. Address inquiries to The Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio

STOCK ENGINEERING CO.

S.E.Co. Coal Valves and Coal Scales, CONICAL Non-Segregating Coal Distributors

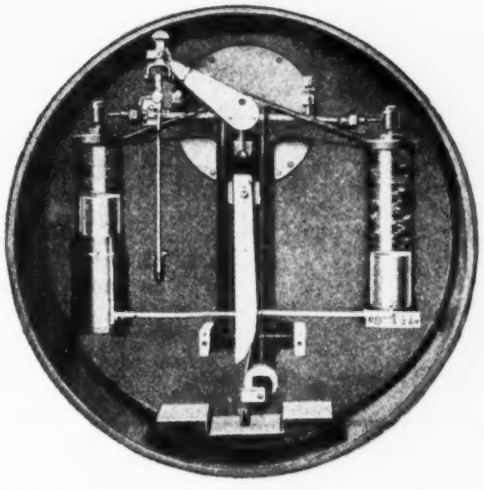
The Story of the Dirty Boiler Room and the Flow Meter with the Cracked Glass



This one belongs in the famous "Believe It or Not" series of Robert L. Ripley:

A Cochrane Flow Meter, of the tilting U-tube type, was installed in a boiler room, which, far from being the bright, clean, "eat-off-the-floor" variety the readers of this magazine are familiar with, was very dirty indeed. The operators, again unlike our readers, were probably rather careless, for the glass on the meter door was cracked and no one bothered to replace it. The meter, being of the indicating type, required no change of chart, or other excuse for opening the door, but continued to function properly for two years. Then there was an inspection, and it was found that the meter case was half-filled with coal dust... and that the tilting manometer had kept ploughing a clear path for its operation. Its accurate performance had not been affected. That's POWER!

What is the secret of this power inherent in every Cochrane Tilting U-tube type of Flow Meter?



Simply this: the difference in rate of flow in the pipe line changes the level of the mercury in a sealed U-tube which is balanced on a knife-edge bearing. As the mercury shifts from one side to the other of the U-tube, the balance swings, moving indicator, pen arm and integrator to record the change in flow.

Simple . . . powerful . . . never-failing. If you have a tough metering job, if your operators are unskilled in instrument care and maintenance, if you want the simplest and most powerful flow meter made, this Cochrane Tilting U-tube Meter was made for you. Write today to Cochrane Corporation, Flow Meter Division, 3106 N. 17 St., Philadelphia 32, Pa.

New Model A-1 *Pur-O-fier*

For Compressed Air

Positive purification of air lines is assured with this new Model A-1 Pur-O-fier designed to eliminate free moisture, oil and foreign matter in small compressed air systems. It operates with from 1 to 5 cubic feet of air and for intermittent operations is extremely sensitive to the slightest movement of air. Weighing only 1¼ lbs., this new unit is just 3⅛" in diameter by 5⁹⁄₁₆" deep including plastic, transparent entrainment sump. Model A-1 Pur-O-fier requires no maintenance.

Drain valve permits easy and quick draining of the sump. Pur-O-fier uses positive, centrifugal action as a medium for purification and can be used for air-operated instrument controls, air-operated gauges of the precision and checking type, and air-operated cleaning devices of many types. This unit will operate effectively from 1 to 75 P.S.I. Write for bulletin No. 11 giving complete details.

Patent applied for

Write for New Bulletin No. 11 giving complete specifications and applications

BIRD-WHITE COMPANY
3120 WEST LAKE STREET
CHICAGO, ILLINOIS

HIGHEST-PAID
ENGINEERS
of Outstanding

FACTORIES
RAILROADS
SHIP LINES

show impressively better performance almost immediately with

No-Karb Soot Remover
(for coal or oil, high or low pressure boilers)

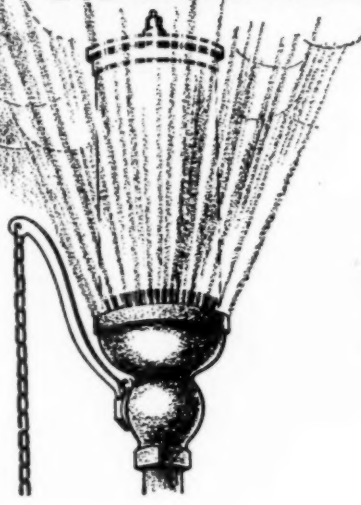
NCC Sludge Solvent
(for oil-fired, high or low pressure boilers)

The factual story is big and important.
Write for it today and decide for yourself.

NUTMEG CHEMICAL CO.
223 State Street, New Haven 10, Conn.

Distributors! Salesmen! A few choice territories open.

QUAKER PACKINGS...



Reg. U. S. Pat. Off.

.... a proper type for any condition

Over sixty years Quaker has been manufacturing a complete line of Rod and Sheet Packings. In fact it is *the* complete line.

For old equipment, for new equipment . . . for all kinds of Service conditions . . . low pressures, or high pressures . . . cold water or steam . . . water, oil, acids or any other kind of liquid . . . air, steam, vapor or vacuum.

In Rod Packing the Quaker line comprises construction of rubber, flax, duck, asbestos, metallic in coil, ring and spiral form.

In Sheet Packing the Quaker line includes rubber, cloth insertion, fibre and asbestos.

Regardless of the service you may require, there is a Quaker Packing to meet that condition.

Consult Quaker if you have any packing troubles. Our Packing Experts are at your service any time.

If there is a way to get it done **QUAKER** *will do it*

QUAKER RUBBER CORPORATION
Mfrs. Industrial Rubber Products
PHILADELPHIA 24, PENNSYLVANIA
NEW YORK • CLEVELAND • CHICAGO • HOUSTON

Western Territory
Quaker Pacific Rubber Company
San Francisco • Los Angeles

A NEW BULLETIN FOR ENGINEERS and TECHNICAL MEN

BULLETIN 113 DESCRIBES

Globeiron

SEAMLESS PRESSURE TUBING

GLOBEIRON Seamless Pressure Tubing (99.5% pure iron) is manufactured by piercing solid rounds and rolling them into tubes. It is pressure tubing that is easily formed or welded and offers unusual qualities of corrosion resistance — ductility — toughness.

Boiler tubes of Globeiron are easily rolled in and beaded; condenser tubes may be expanded, flared, or flanged readily because of the ductility and toughness of Globeiron.

Bulletin 113 gives the complete facts on Globerion advantages — write for your copy today.

GLOBE TUBES

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES
★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL Tubes

5015

GLOBE STEEL TUBES CO., Milwaukee 4, Wis., U.S.A.

BROWNELL STOKERS

For those interested in a *good* stoker for plant, institution, office building, hotel, apartment or home, there's a Brownell Underfeed to suit your requirement up to 499 h.p. with single retort—larger industrial sizes with twin retorts.

Write for illustrated bulletin

THE BROWNELL COMPANY — The World Over — DAYTON, OHIO, U.S.A.

FIG. 1

Specify: ERNST

HIGH and LOW Alarm Water Columns

EQUIPPED WITH INCLINED GAGES

SPLIT GLAND TYPE **OR** PRISMATIC REFLEX TYPE

FOR ALL PRESSURES AND TEMPERATURES

Send for Catalog 45

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, NEW JERSEY

Telephone Livingston 6-2356

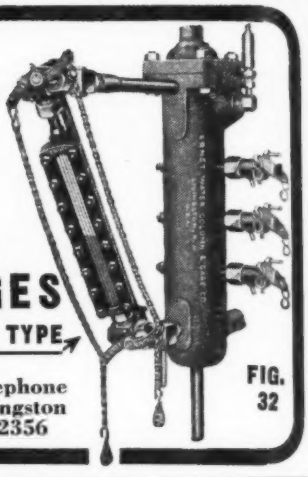
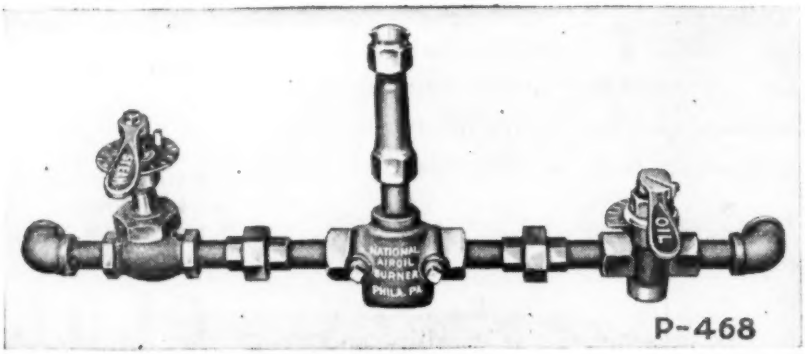


FIG. 32

NATIONAL AIROIL FUEL OIL - GAS BURNERS

for VERTICAL FIRING ⬆UPWARD or DOWNWARD⬇

The 32 years experience of the National Airoil Burner Company in the design and manufacture of oil and gas burners, naturally led to the development of entire combustion units for firing vertically, upward or downward. We have made numerous successful installations of this type, many of which are quite large, for firing Boilers, Steam Superheaters, Direct Fired Air Heaters, Chemical Retorts and Kilns.



In the illustration we show the assembly of our special up-fired S. A. R. Oil burner with oil (at right) and steam (at left) control valves.

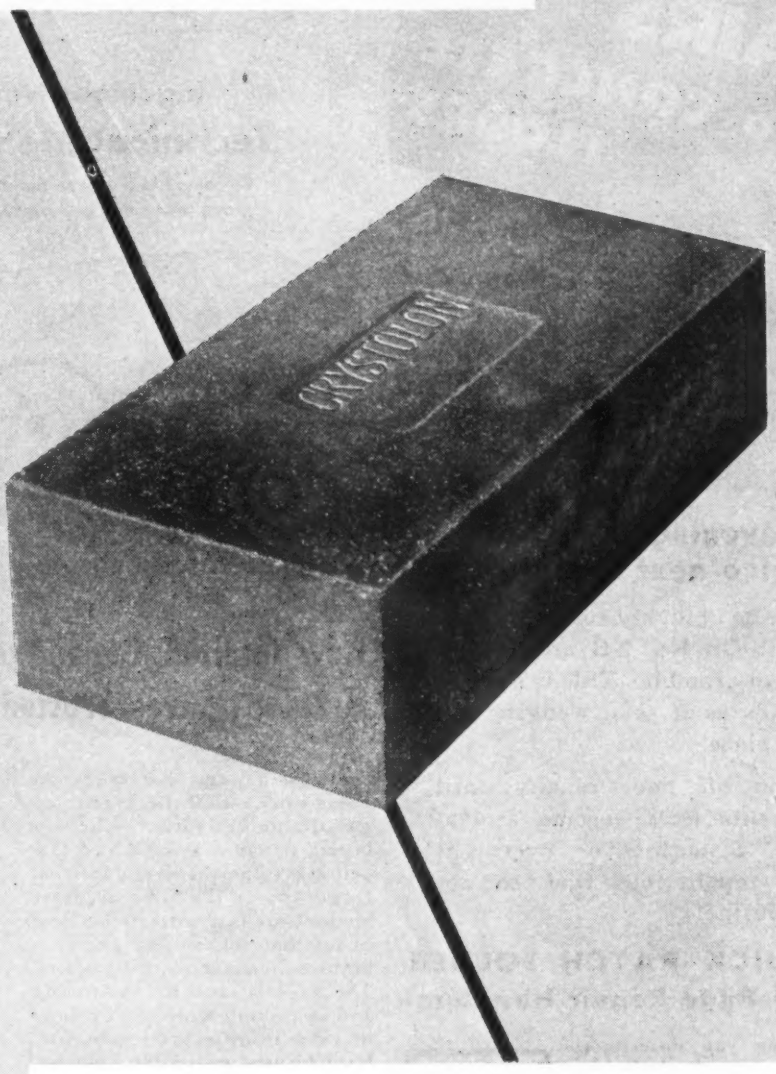
Regardless of the size of the installation we can supply oil-gas burning equipment to meet your specifications . . . call on us.

NATIONAL AIROIL BURNER Company, Incorporated

1250 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PENNA.

OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS • EXPLOSION DOORS
ACCESS DOORS • AIR DOORS • BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

CRYSTOLON BRICK For Heavy Duty . . .



High refractoriness, chemical stability and resistance to abrasion and to slag penetration make CRYSTOLON (SiC) Brick ideal for heavy duty work in stoker-fired furnaces, generators of water gas sets and combustion chambers of high temperature furnaces. The dense surface of CRYSTOLON Brick resists slag penetration so that clinkers are easily removed leaving the brick clean and undamaged.

NORTON COMPANY **Worcester 6, Mass.**

Norton Longer Lasting Refractories

IRON-HARD PERMANENT REPAIRS to CONCRETE FLOORS

Smooth-On No. 7-B Quick Patch Cement is easy to use, sets overnight, stays in place, is economical.

Applied in the evening— Ready for service next morning

Besides hardening quickly, floor repairs made with Smooth-On No. 7-B are durable and do not loosen or crumble. This is because Smooth-On expands as it sets, wedging the patch tightly in place.

No need to put off floor repairs until cracks, holes or ruts have become a dangerous menace. Smooth-On's overnight hardening means repair jobs that do not interrupt plant routine.

FREE QUICK PATCH FOLDER, 40-Page Repair Handbook

The coupon will bring you descriptive folder on Smooth-On No. 7B Quick Patch and also the Smooth-On Repair Handbook showing ingenious repairs to plant and home equipment using the other Smooth-On Cements. 170 diagrams. Pocket size.

Order Smooth-On No. 7-B Quick Patch in 5-lb., 25-lb. or 100-lb. sizes.

Fill Out and Mail *NOW*

Smooth-On Mfg. Co., Dept. 30
570 Communipaw Avenue, Jersey City 4, N. J.

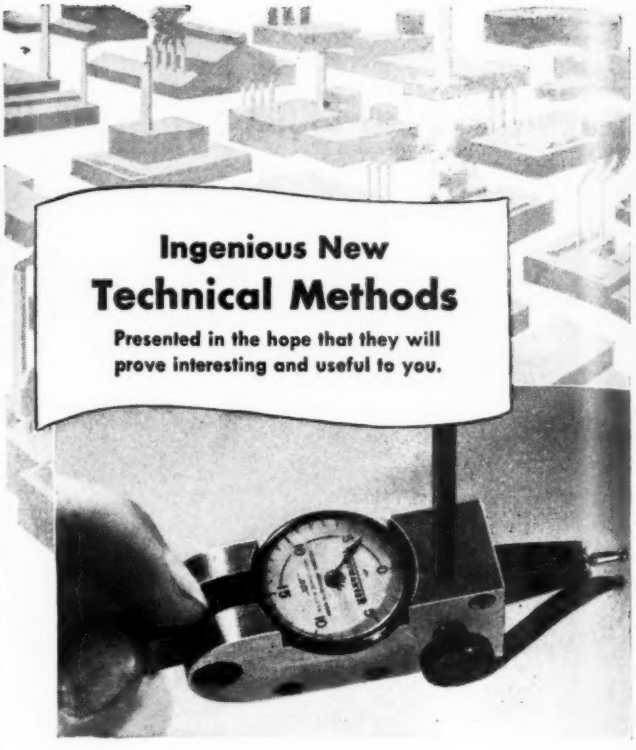
Please send me Quick Patch folder and Smooth-On Repair Handbook

Name .....

Address .....

1-45 .....

Do it with SMOOTH-ON
The Iron Repair Cement of 1000 Uses



Ingenious New Technical Methods

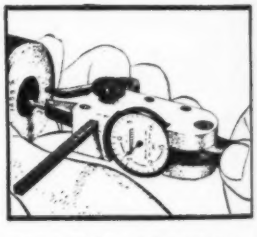
Presented in the hope that they will prove interesting and useful to you.

New Internal Gage Avoids Over Cutting . . . Saves Wasted Man Hours

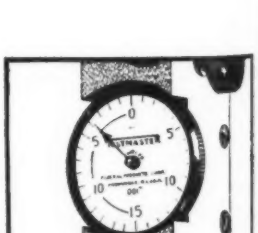
At last a gage that takes the guess work out of checking internal diameters either machine bored, or close ground and lapped. It is called the Keene Internal Gage and is the first accurate method for fast correct checking of internal splines and gears on both minimum and root diameters. The gage is ideal for machining and inspection work, and proves its value in increased production. It can be used with either a master, or micrometers.

This time saving development is constructed of aluminum, is six inches long and weighs only five ounces. Available in models designed to read in thousandths (.001) or in tenths (.0001).

When your gage has been checked the thousandths left to bore, the actual job of machining may become tedious. It is then when Wrigley's Spearmint Gum helps keep you alert and watchful. Chewing gum seems to assist you over the dull spots in the day's work. And Wrigley's Spearmint will aid you in your peacetime job by helping to keep you wide awake and efficient during that part of your work that may seem unimportant, but which actually means perfection to the completed product.



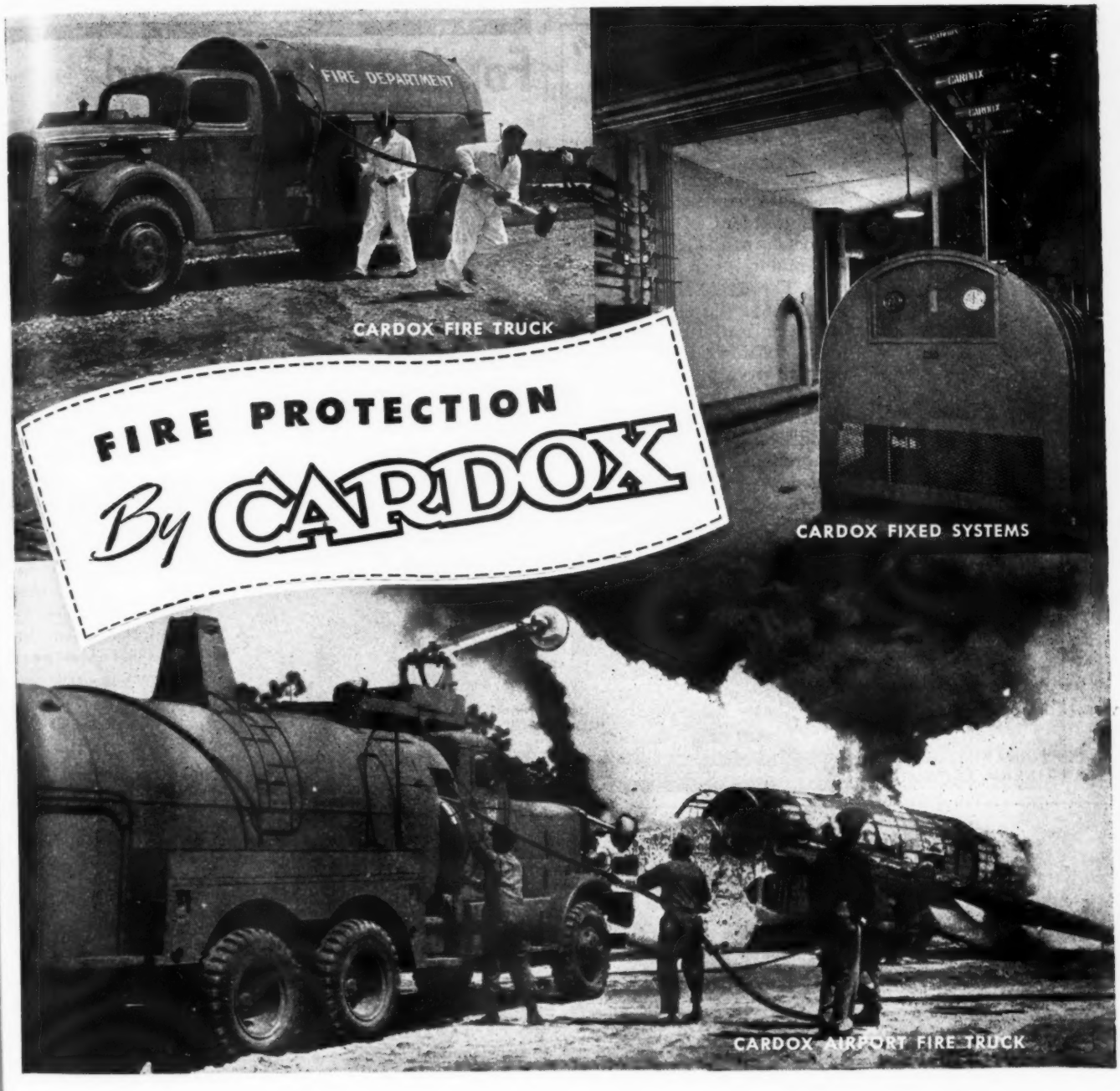
Determining correct setting for gage.



Closeup of dial showing simplicity and fast visibility.

You can get complete information from Keene Electrical Machinery Co., 542 W. Washington Blvd., Chicago 6, Illinois

Z-52



In and around America's vital war plants . . . on our big and busy military airfields . . . fire protection is provided by Cardox Fire Extinguishing Systems, Fire Trucks and Airport Fire Trucks.

Each is a highly specialized fire extinguishing tool . . . exactingly engineered to do a specific job quicker and more effectively than it has been done before. But all Cardox Systems and Mobile Units have one outstanding characteristic in common: *Cardox Engineering in the application and control of carbon dioxide, stored at 0°F. and 300 p.s.i. in a single Storage Unit containing from ¼ to 125 tons of fire-destroying Cardox CO_2.*

For Cardox has given the recognized advantages of carbon dioxide a new and broader scope of fire extinguishing performance. Because of this, these advantages can be applied equally well to small or *very large* fires through *mass* application of Cardox CO_2, released in *pounds* or *tons*.

The efficiency of Cardox Systems and Mobile Units in giving fast-acting, nondamaging carbon dioxide *enhanced extinguishing* performance is made possible by Cardox methods of control and application that give Cardox CO_2: (1) Uniform extinguishing characteristics regardless of plant or atmospheric temperatures; (2) Availability in ample quantity for uninterrupted protection and mass application at high rate; (3) High CO_2 "snow" yield for increased cooling effect; (4) Effective projection through relatively great distances.

On the basis of this performance Cardox has been given many of the toughest fire protection assignments—*all over the country*. Find out how through practical cooperation Cardox and its engineering staff can assist you to make your planned fire protection more effective. Write on company letterhead for Bulletin 915.

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in New York • Boston • Washington
Detroit • Cleveland • Atlanta • Pittsburgh
San Francisco • Los Angeles • Seattle

"Industrial"

Cut Gears • Cut Sprockets

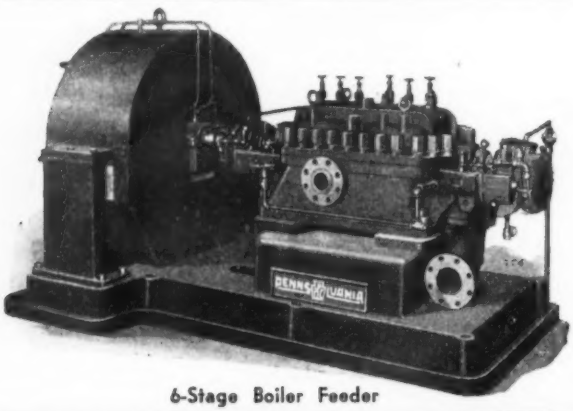
OUR vast production capacity is at your command for Cut Gears and Sprockets of all types—from any material—in any quantity. Through "Industrial" you obtain the advantages of specialization . . . we make nothing else . . . thus we can serve you better.

Write for our new Gear Catalog and Engineering Handbook. It's the most comprehensive manual ever published for gear users and buyers.

INDUSTRIAL GEAR MFG. CO.

THE PLANT THAT QUALITY AND SERVICE BUILT

4543 VAN BUREN STREET
CHICAGO 24, ILLINOIS



6-Stage Boiler Feeder

THRUSTFRE PUMPS

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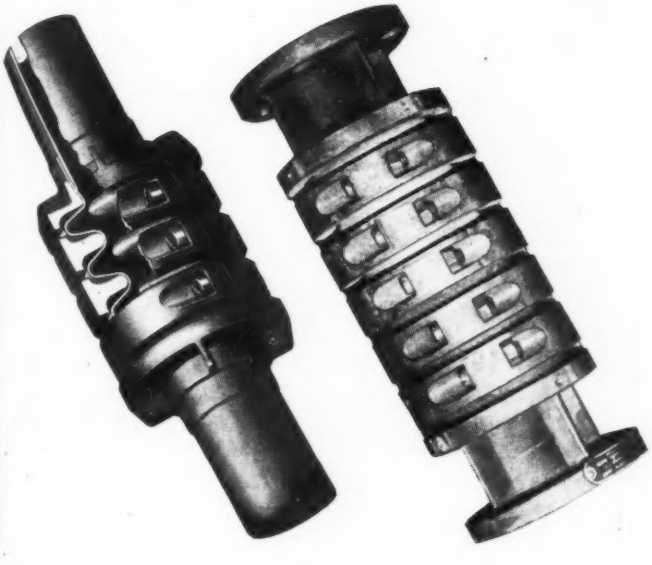

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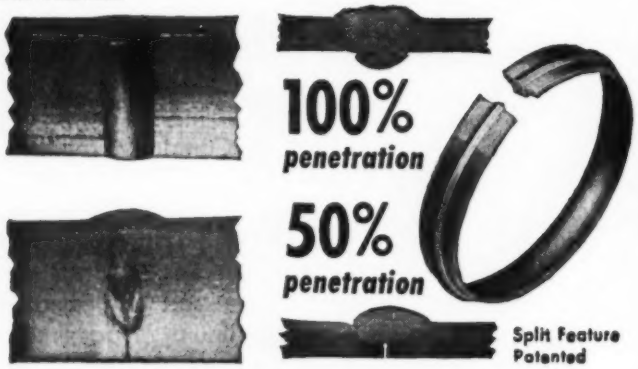

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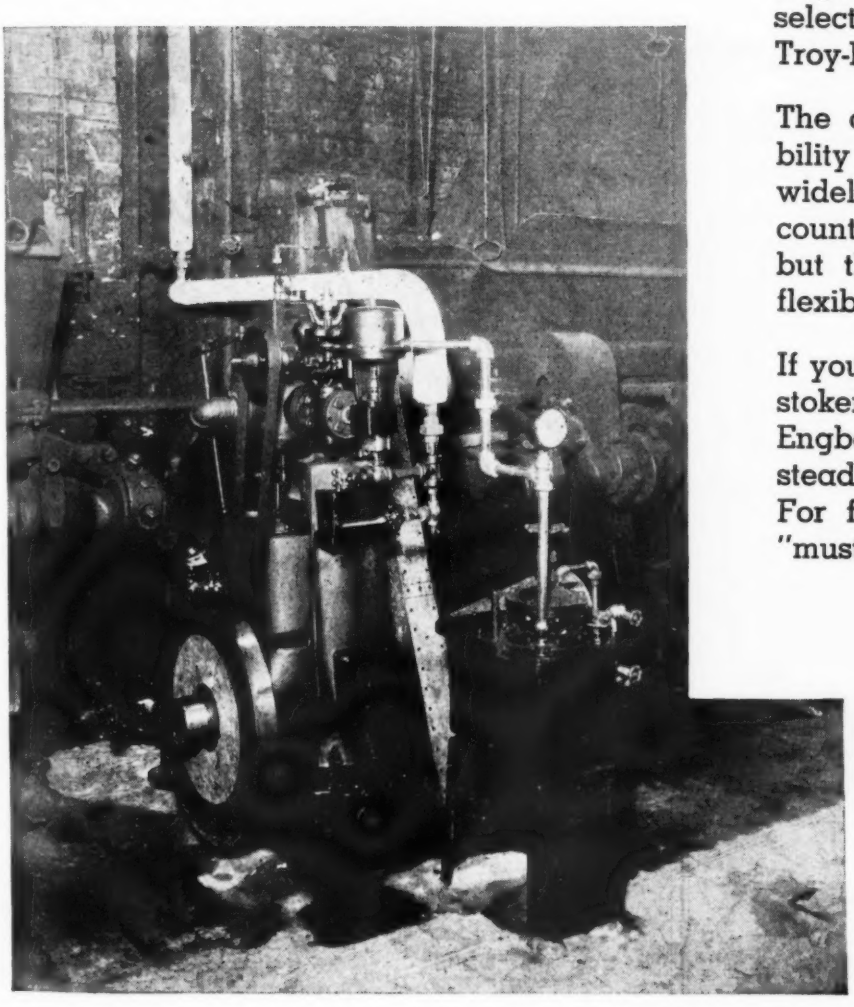

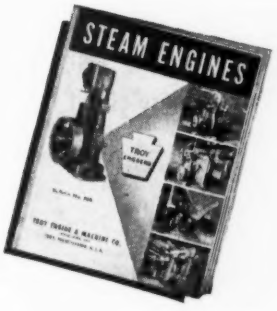

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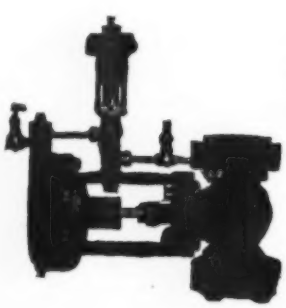

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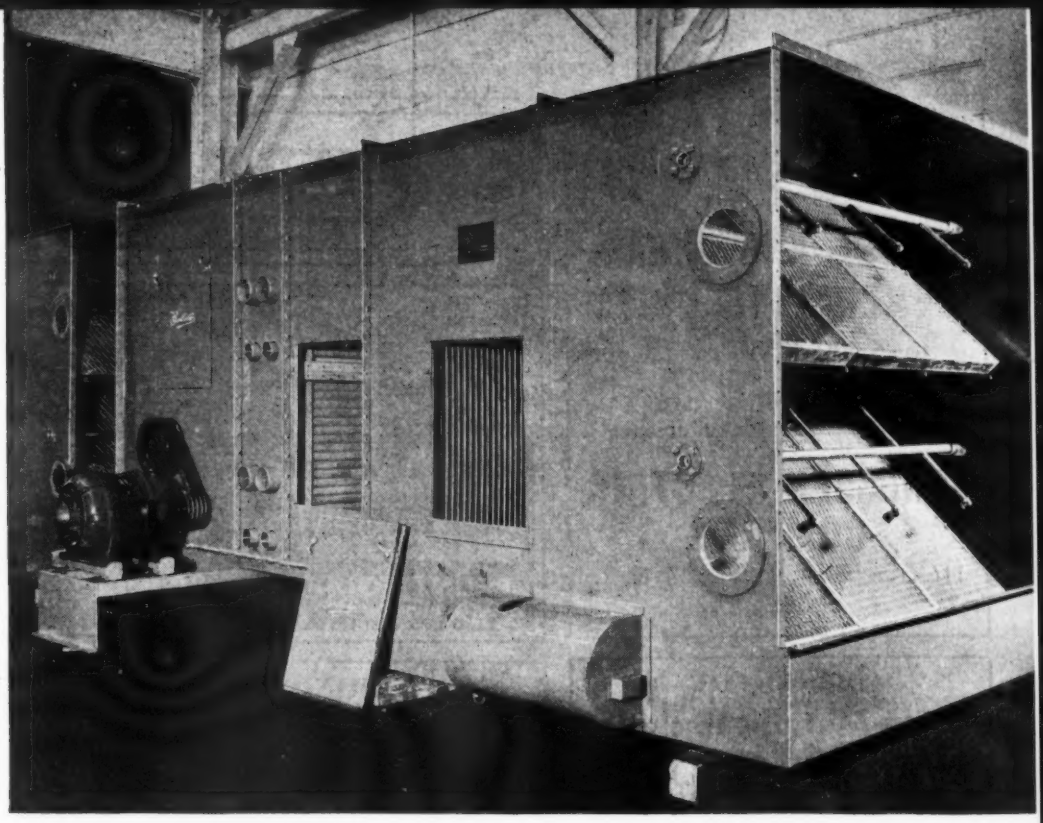

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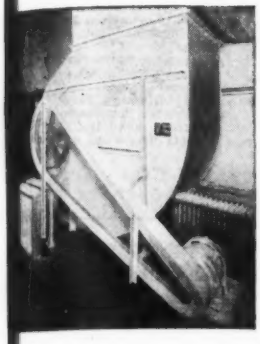

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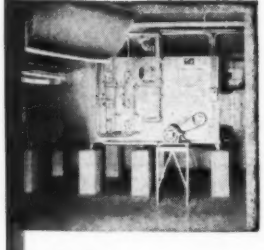

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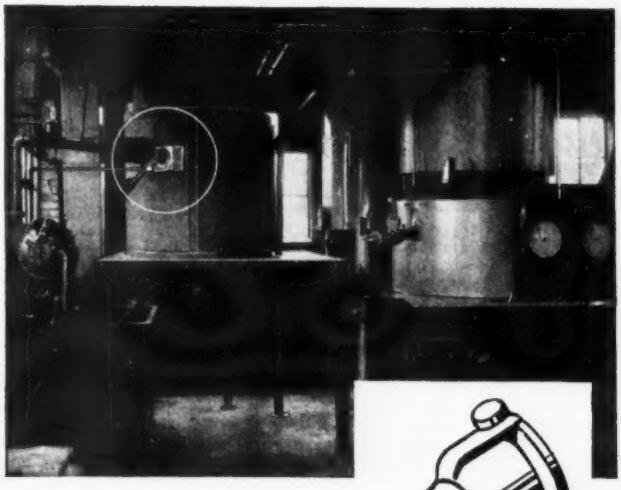

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200 H.P. Fairbanks Morse, 3/60/2200 V. Generator.
280 H.P. Fairbanks Morse 32-D Diesel, 3/60/480.
360 H.P. Ingersoll-Rand, 3/60/2300 Volt Generator.
500 H.P. Fairbanks Morse 33-D Diesel, 3/60/480.

R. C. STANHOPE, INC.
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DIESEL ENGINES
BOUGHT—SOLD

One of the Largest Used Stocks in the East. Send us your offerings and inquiries.

ALJON ELECTRIC DIESEL CO.
151-5 Washington St. B'klyn., N. Y.
Main 4-3804-5

FOR SALE — PULVERIZERS

2—Aero Foster Wheeler Size F 5000# Coke per hour each, with 50-H.P. Ty F.T. G.E. Motors 440-volt 60 cycle 95% New $3,750.00 each.

BEVIS MACHINERY COMPANY
585 S. Santa Fe Ave. Los Angeles 13, Cal.

2—180 H.P. Fairbanks Morse, Model 32E12, Diesel Engine, 3 cylinder, 360 RPM, with or without A.C. generators

SAMUEL M. DAVIS
3624-12th Avenue, Brooklyn 18, N.Y.
Phone Windsor 5-2792

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Established in 1910

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AVAILABLE FOR IMMEDIATE SHIPMENT

1—General Electric turbo generator 3 phase 60 cycle, 5000 KVA, 2300 volts, 3600 RPM with Worthington surface condenser and switchboard.
6—Babcock & Wilcox boilers 600 HP each 200# pressure.
1—Synchronous condenser 3000 KVA.

Write or wire us for complete specifications

Also send us your requirements for boilers turbo generators Diesel engine generator sets steam engine generator sets motor generator sets transformers and motors both AC and DC.

WANTED

NEW PRODUCTS WANTED

By 40 Year Old Manufacturer of

POWER PLANT SPECIALTIES

This manufacturer is an acknowledged leader in his field, has an exceptionally strong financial position and has a nationwide sales organization. He is interested in adding to his line of steam power plant specialties several new products with good postwar sales possibilities. He has a research organization capable of thoroughly testing new products and doing any additional development work found necessary. Write to

WITTE & BURDEN • ADVERTISING
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TURBO-GENERATORS

1—940 KVA and one 625 KVA 2400 volt, 3 phase, 60 cycle Turbo-Generator Sets complete with condensers and auxiliaries.

Equitable Equipment Company, Inc.
410 Camp Street, New Orleans, La.

WANTED

300 HP Corliss Engine, heavy duty preferred; or 300 HP Turbine.

EVANGELINE PEPPER & FOOD PRODUCTS
St. Martinville, La., U. S. A.

WANTED

Direct Current Motor

175 H.P. type DMC class 200 500 RPM form L 230 volts. Reply

W-748, Power
330 W. 42nd St., New York 18, N. Y.

WANTED

Alternator—300 RPM
Engine type, 300-400 KVA

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Stanton, Ky.

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TRANSFORMERS CONTROLS
MOTORS MOTOR GEN. SETS
AIR OIL CIRCUIT BREAKERS

POWER EQUIPMENT COMPANY
156 Andrews St., Rochester 4, N. Y.
Telephone Main 568 or 569

WANTED

D. C. 3 wire 120-240 V. preferably interpole with 4 valve or uniflow Engine 100-125 KW.

ARNESSEN ELECTRIC CO.
116 Broad Street, New York
Bowling Green 9-8542

FOR SALE
ALL NEW IN 1943

Completely Equipped Electrolytic Hydrogen and Oxygen Plant

Capacity—55000 cu. ft. of hydrogen per 24 hour day.

Complete with—

1—450 KVA—G.E. pyranol transformer 4160/440v. 3 phase 60 cycles.
2—Motor generator set—Hanson Van Winkle Munning 450 H.P. G.E. synchronous motor, 440v. 3 phase, 60 cycle.
DC generator—40 volts, 8000 amperes.
DC exciter.
All mounted on same shaft.
3—Starting panel, switchboard, instruments, & busbars, etc.
4—20—electrolytic cells—Canadian G.E. Stuart type 7500 ampere.
1—3 ton Wright—overhead traveling crane—hand operated.
5—2 Nash Hytor gas pumps.
6—2—Single lift gas holders—700 cu. ft. & 350 cu. ft. with counter weights.
7—2—Single lift gas holders.
30,000 cu. ft.—5 inches static pressure.
15,000 cu. ft.—13 inches static pressure.
8—Continuous gas analysis recorder.
9—Flow meters.

REFRACTORIES

3000 approx. Armstrong A-16 insulating refractory brick
1200 approx. Armstrong A-23 insulating refractory brick
2500 approx. Seaboard "Kynex" fire brick

BULOVA WATCH COMPANY
VALLEY STREAM, L. I.

Below BERGER OFFERS

Rebuilt and Sold with a Standard New Guarantee

ONLY PARTIAL LIST

TRANSFORMERS

1—200 KVA GE, type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—200 KVA GE, type H Form VD 4800/2400/480 volts, 1 PH. 25 cy.
1—100 KVA GE, type H Form KDD 11000/2600 volt. 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
3—75 KVA Gen. Elect. K.S. 1 ph. 60 cy. 2300/115/230 volts.

OTHER SIZES VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

250 K.W.—(312 KVA) Gen.-Elect., Type A.T.I.—2300/4600 volt, 60 cycle 150 R.P.M. P. F. .08 with separate belted exciter.
240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle, 3 phase, 450 R.P.M. with direct connected exciter.
200 K.W. Westh. Unity Power Factor. 3 PH, 60 cyc. 220/440 900 R.P.M. with direct connected exciter.
150 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts, 600 R.P.M. Revolving field with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 with Rev. Field, and built in Exc.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.

CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
35 H.P.—G. E. Form D—550 Volts—590 RPM

MOTOR GENERATOR SETS

Gen.-Elect—100 KW. 2 brg. 125 volts D.C. Comp WD-Int. with 220/400 volts, Sq. Cg. Motor.

FREQUENCY CHANGERS

30 K.V.A. Gen. Elect. type I.T.T. frame 526 P.F. .08—220/440 volts 3 Ph. 60 cy. to 240 volts 120 cycle Motor KT frame 526—3 Ph. 60 cy. 220/440 volts 1800 RPM.

ALL SIZES VOLTAGES AND CYCLES

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volts
350	Gen. Elec.	Sl. Rg. 3 Brg.	I	375	440
200	Lincoln	S. R.	I. X. W.	500	440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
150	Wagner	Sq. C.		500	220/440

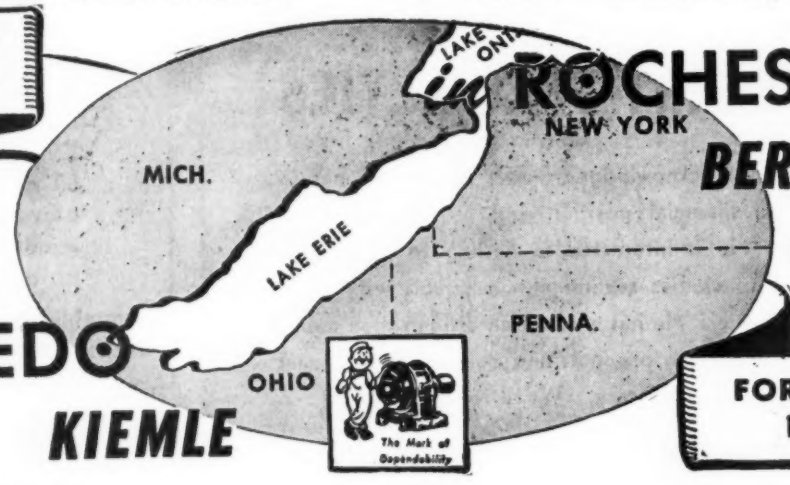
3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
200	West.	Syn.-Dir. Con. Ex.	P. F. .08	900	220/440
200	Gen. Elec.	Syn.	ATI	514	4000/2300
200	Weghse.	Syn.	Dir. Con. Exc.	600	2300
150	Burke	Sq. Cg.	3 Bg. 2 Ph.	900	220/440
125	Gen. Elec.	S. R.	MT553	1200	440
25	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

230 D. C. Motors

H.P.	Make	Type	Speed
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	1700
60	Sprague	D — Comp. Wound	625
40	Fair. Morse	Ball BRG. Vert. Comp.	1740

OVER 10,000 STOCK ITEMS



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D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V. 600 R.P.M.
50 KW Gen. Elec. DLC—Comp. Ind. 125 V.—1150 R.P.M.
50 KW—Northern—Comp. 110 V.—700 R.P.M.

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300 1 phase 25 cycle.
1—350 KVA, GE, type H-K.D.D. 2300/460—1 PH, 60 Cy.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
3—75 KVA Pitts. 1 Ph. 60 cy. 2300/230/115 volts.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

10 K.W. Gen. Elect. 1 Ph. 60 Cy. 220 Volts—1800 R.P.M.

WEST. D.C.—VARIABLE SPEED MOTORS

10—10 H.P. Type S.K. 230 V. 500/1500 R.P.M. with Automatic Dynamic Braking Starters and Field Rheos.

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed with transformers for 2300 volts to 230 volts D.C.

125 D. C. Motors

H.P.	Make	Type	Speed
60	Allis Chalmers	FB131-Comp.	1755

550 D. C. Motors

H.P.	Make	Type	Speed
35	West.	SK150 Shunt Int.	085

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
200	Wghse.	Sl. Rg.	CW	600	220/440
150	Gen. Elec.	Sq. Cg.	I.K.	600	2300
100	Gen. Elec.	S. C.	K.T.	720	440
100	Gen. Elec.	S. C.	KT553	1150	440
100	Lincoln		M	1150	440
100	Gen. Elec.	R	MT	600	440

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volts
150	Gen. Elec.	S. R.	IM	500	440
100	Allis Ch.	S. R.		750	440
75	Gen. Elec.	Var.	BTA	375/750	440
75	Gen. Elec.	S. R.	I. M. 17B	160	440
75	Gen. Elec.	Sl. Rg.	I. M.	750	220/440

230 D. C. Motors

H.P.	Make	Type	Speed
150	West.	SK 180L Comp. Wd. Int.	1150
100	Northwestern	K30 Comp. Inter.	1750
50	Crocker Wheeler	CM	625

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Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

Above KIEMLE OFFERS

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WHY Hemphill SETS THE PACE IN SUPPLYING GOOD USED

POWER EQUIPMENT

Hemphill Buys First

The value of the equipment we offer you is prejudged by Hemphill experts — i.e. we buy or acquire control. We don't expect YOU to put money into equipment that we won't invest in first.

Engineered Supervision

Graduate Electrical Engineers supervise the value of all equipment we buy or control. These men not only judge equipment before we take over — but before YOU take over, after any needed rebuilding.

Supervised Rebuilding

The Hemphill rebuilding shops, staffed by experienced workmen, are under the supervision of Electrical Engineers, who decide what rebuilding is needed and check finished test performances.

Advisory Service

Customers often find it well worthwhile to consult Hemphill Engineers as to "the best way to do the job," of selecting and utilizing equipment, no matter how small or how big and complex.

Warehouse Location

From the standpoint of "logistics" (transportation) the location of our warehouse and shops insures rapid deliveries by rail, truck or water.

Sealed for Quality

The Hemphill Seal on all equipment we rebuild guarantees that the standard of test requirement is up to or exceeds that of the original manufacturer.

MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM, Lincoln, 440 volt, slip ring.
1—400 HP, 1200 RPM, 220 volt, Westinghouse squirrel cage.
1—350 HP, 300 RPM, 440 volt, General Electric slip ring.
1—300 HP, 450 RPM, 440 volt, General Electric slip ring.
1—200 HP, 600 RPM, 2200 volt, G. E., sl. rg.
1—150 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
1—150 HP., 1750 RPM, Westinghouse, sl. rg.
2—150 HP, 1200 RPM, 2200 volt, Westinghouse, squirrel cage.
1—150 HP, 600 RPM, 220 volt, General Electric, synchronous.
1—150 HP, 400 RPM, 440 volt, General Electric, squirrel cage.
1—125 KVA, 900 RPM, 220 volt, Westinghouse, synchronous.
1—125 HP, 720 RPM, Allis Chalmers, sl. rg.
1—100 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, RPM, 550 volt, Cr. Whir. sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—60 HP, 1200 RPM, 220 volt, General Electric, slip ring.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
1—150 HP, 750 RPM, Electro Dynamic.
1—150 HP, 500 RPM, General Electric, type MPC.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 300 RPM, G.E.
1—30 HP, 750 RPM, G.E., Type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.

The Seal of Quality GUARANTEES all HEMPHILL Reconditioned Equipment

MOTORS—D.C. 230 VOLTS (Con't)

1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
1—15 HP, G.E., 800 RPM, Type RC-11.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—60 HP, 500/1000 RPM, Diehl.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
1—25 HP, Westinghouse, 650/2200 RPM, Type SK-110Ia.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
3—11½ HP, 500/1500 RPM, Westinghouse.
1—10 HP, 400/1600 RPM, Westinghouse.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

MOTOR GENERATOR SETS

1—750 KW, 250 volt, Allis Chalmers, synchronous.
1—75 KW, 125 volt, General Electric, squirrel cage.
1—20 KW, 600 volt, General Electric, squirrel cage induction motor.
2—15 KW, 250 volt, General Electric, squirrel cage.
1—6½ KW, 125 volt, General Electric, squirrel cage.

TURBO GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., con.
1—200 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—30 KW, 135 volt, Allis-Chalmers non-condensor.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 2300 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

TRANSFORMERS

2—400 KVA, G.E., 4156-250/480 v., Scott taps.
3—300 KVA, Pittsburgh 7800/440 volts.
3—200 KVA, Allis-Chalmers, 2200-220/110.
3—150 KVA, G.E., 33000/2300/4000 Y.
4—150 KVA, General Electric, 2200/220/440 volts.
2—100 KVA, General Electric 2200/220/440 volt.
3—100 KVA, Westinghouse, 11,430/250 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—100 KVA, Allis-Chalmers, 2200/220/110 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
2—50 KVA, Phgh. 7500/15000 volts-110/220 volts.
2—15 KVA, G.E., 2300-115/230 volts.
2—100 KVA, G.E., 2400/240/480.

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MOTOR GENERATOR SETS

300 KW West. 250/125 v. d. c. 3 wire type SK 1150 RPM Factory built on C. I. sub-base. Direct Coupled to 3 ph. 60 cy motor with A. C. and D. C. Control.

250 KW G. E. Type MPC 125 v. d. c. 2000 amp. Factory built on C. I. sub-base direct coupled to 3 ph 60 cy motor with A. C. and D. C. Control.

40 KW Reliance 230 v. separate excited with 3 ph 60 cy 220/440 v. A. C. Motor.
10 KW Reliance separate excited vertical variable voltage 230 v. direct current, with 3 ph. 60 cy. 220/440 v. A. C. Motor.

DIRECT CURRENT

(Partial List Only)

230 VOLT DC MOTORS

H.P.	Make	Speed
60	El. Dynam.	900
60	G.E.	480/1100
50	West.	550/1100
50	G.E.	850
45	Diehl	850/1020
40	Cr. Wh.	915
35	West.	1150
25	Diehl	850/1020
25	G.E.	1150
25	G.E.	575
20	R & M	1160
20	G.E.	1150
20	West.	1150
20	G.E.	800 (2)
15	West.	1250
15	G.E.	1150
15	Cr. Wh.	900/1800
15	West.	850
10	West.	850
10	G.E.	825
10	G.E.	700
10	Al. Ch.	600/1800
10	West.	600/1200
10	G.E.	400/1600
10	West.	400/1200
9	G.E.	450/1800
7½	Peerl's	1700
7½	West.	1450
7½	West.	1150 (2)
7½	G.E.	1150
7½	West.	975
7½	Al. Ch.	850
7½	El. Dy.	550/1650
7½	Watson	525/1150
7½	G.E.	400/1600
7½	West.	400/1600
7½	Al. Ch.	350/1050
7½	G.E.	300/1200
6	G.E.	400/1200
6	G.E.	450/1800 (2)
5	West.	850
5	G.E.	900 (2)
5	West.	1800
5	G.E.	1150 (2)
5	Cont.	600/1800
5	West.	850
5	Star	600/1200
5	El. Dy.	550/1650
5	G.E.	450/800
5	G.E.	600
5	G.E.	450/1350
5	West.	400/1200
5	El. Dy.	275/1100

236 additional 230 volt D. C. Motors in stock as small as 1/20 H.P.

BELTED AND MOTOR DRIVEN DC GENERATORS

100 KW West.	250 volts
75 KW West.	250 volts
60 KW G.E.	600 volts
60 KW G.E.	125 volts
50 KW G.E.	250 volts
50 KW West.	125 volts
45 KW West.	250 volts
30 KW El. Dy.	600 volts
40 KW Cr. Wh.	125 volts
30 KW West.	125 volts
25 KW West.	125 volts
25 KW G.E.	250 volts
20 KW G.E.	125 volts
15 KW West.	125 volts

43 additional Motor Generator Sets, 30 volts, 60 volts, 125 volts, 250 volts, and 250 volts as small as ½ K.W.

ALTERNATING CURRENT

(Partial List Only)

2 & 3 PHASE SLIP RING

H.P.	Make	Speed
250	G.E.	600
112	G.E.	900
100	F.M.	690
75	West.	1170
75	Al. Ch.	575
64	G.E.	585
60	West.	1135
60	West.	290
50	G.E.	870 (2)
50	West.	850
40	Wagner	1150
40	F.M.	870
40	West.	870
40	Linc.	690
30	G.E.	870
30	G.E.	690
15/35	West.	6/1200 (5)
25/55	G.E.	6/1200
20/50	West.	6/1200
25	Al. Ch.	870 (2)
25	West.	850
25	G.E.	870 (2)
25	G.E.	720
25	West.	575
20	G.E.	870
20	West.	575

116 additional Slip Ring Motors in stock down to ⅓ H.P.

3 PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
200	G.E.	600
150	G.E.	860
150	West.	715
100	G.E.	1200
100	G.E. (BTA)	375/750
75	West.	870
50	West.	1200
50	G.E.	900
40	G.E.	900
35	Wagner	850
30	U. S.	3450 Vert.
30	Al. Ch.	514
25	Wagner	1200
25	West.	1140
25	Diehl	865
25	G.E.	900
25	Wagner	720
20	G.E.	1750
20	G.E.	1200
20	Cr. Wh.	1200
20	Al. Ch.	900
20	Diehl	900
20	G.E.	720
20	West.	1720

29—15 H.P. 4 speed 600/900/1200/1800 RPM Constant H.P. Ball Bearing motors, West, and Louis Allis

15	G.E.	1200
15	Wagner	720
15	G.E.	600
10	G.E.	720
10	G.E.	3450
10	West.	1150

325 additional three phase Motors down to ¼ H.P.

SINGLE PHASE MOTORS

H.P.	Make	Speed
20	Wagner	1160
20	Cont.	1165
7½	Cont.	3500

AC GENERATORS

150 KW G.E.	720
125 KW Cr. Wh.	900
100 KVA West.	600
60 KW G.E.	1200
25 KVA West.	1200

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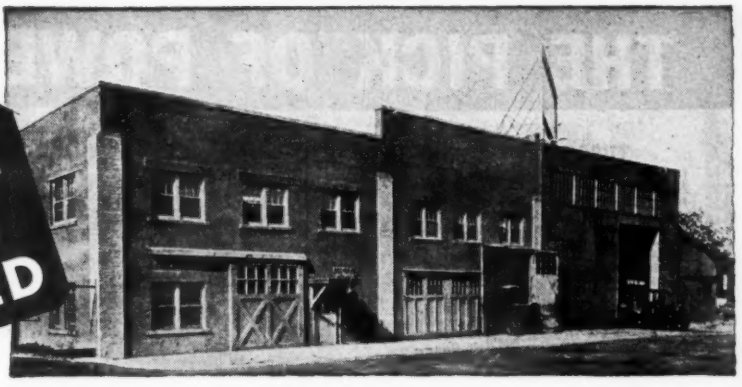

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YOU GET THE *Right* EQUIPMENT

Equipment is right only when suited to your power requirements. With BELYEA it is policy to consider each application problem with the care and exactness that only a professional engineering service backed by 36 years' experience can provide. The large scope of BELYEA stock makes it possible to supply the right equipment, RE-NU-BUILT and rigidly tested to meet high standards of performance. No matter how large or small your purchase, the BELYEA "Guarantee of Successful Operation" protects you.

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1500 KW G.E., 250/275 V. D.C. to 2100 H.P., 2300 V.
1—1000 KW G.E., 250/275 V. D.C. to 1400 H.P., 2300/4150 V.
1—500 KVA—330 KW—220/440 V. A.C. Gen. to 500 H.P.—230 V. D.C. Motor.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.
1—500 KW G.E., 250/275 V. D.C. to 750 Kva 440/2200 V. with exciter.
1—500 KW G.E., 275 V. D.C. to 1000 KVA 2300 V. Syn. Motor with exciter.
1—400 KW G.E., 250/275 V. D.C. to 650 H.P., 2300 V.
1—300 KW G.E., 600 V. D.C. to 435 KVA, 2300 V.
1—250 KW G.E., 275 V. D.C. to 435 KVA, 2300 V.
1—200 KW Whse., 250 V. D.C. to 300 H.P., 2300 V. Syn.
1—200 KW G.E., 125 V. D.C. to 400 KVA, 2300 V. Syn. Motor with exciter.
1—165 KW G.E., 70 V. D.C. to 160 H.P., 2300 V. Syn.
1—100 KW G.E., 125/250 V. D.C. to 150 H.P., 440 V. Syn.
1—100 KW G.E., 250/275 V. D.C. to 150 H.P. 2300 V. Syn.
1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.
1—60 KW Whse., 60 V. D.C. to 75 H.P., 220/440 V. Ind.
1—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.
1—35 KW Whse., 125 V. D.C. to 53 H.P. 440/2200 V., Sq. Cg. Motor.
1—25 KW G.E., 250 V. D.C. to 40 H.P., 220/440 V. Ind. Motor.

3 Phase 25 Cycle

1—25 KW G.E., 125 V. D.C. to 35 H.P., 360 V. Motor.
1—75 KW Whse., 125 V. D.C. to 110 H.P., 440 V. Motor.
1—250 KW G.E., 250 V. D.C. to 285 KVA, 6600 V. Motor.

TURBO GENERATOR SETS

1—300 KW Whse. 625 KVA, 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.
1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lbs. pressure with 12 lb. bk. pres., 2000 RPM.

FREQUENCY CHANGER

1—75 KW G.E., with 94 Kva .8 pf 240 volt type ATB, 3 ph. 62½ cycle gen. and 125 HP 440 volt 25 cycle Ind. motor.
1—1000 KW G.E. with 1250 Kva, .8 p.f. AQB 2300 volt 2 phase (can be changed—800 KW 3 phase) 58.3 cycle gen. and 1400 HP .8 p.f. 440/2200 volt ATI 3 phase 25 cycle motor and exciter.

A.C. MOTORS

3 Phase 60 Cycle

SLIP RING

Qu.	HP	Make	Volts	RPM	Desc.
1	100	G.E.	440	720	IM
2	100	G.E.	2200	575	IM
1	100	G.E.	550	685	MTC-5552
1	100	G.E.	550	720	IM
1	100	G.E.	220	1750	IM
1	150	Whse.	2200	1200	CW
1	150	G.E.	2200	600	IM-16
1	200	Whse.	2200	514	CW
1	200	G.E.	440	600	IM
3	250	Whse.	440/2300	450	CW
1	250	G.E.	4000	257	MT-424Y
1	350	G.E.	4000/2200	253	MT-442Y
1	400	G.E.	2200	252	IP
1	400	G.E.	440/2200	600	IP
1	400	A.-C.	2300	505	ANY
1	450	Whse.	2200	875	CW
1	600	G.E.	550	220	MT
2	600	G.E.	440/2200	720	IP
1	800	A.-C.	440	885	ANY
1	1200	C. W.	2300	237	801Q

SQUIRREL CAGE

Qu.	HP	Make	Volts	RPM	Desc.
1	100	G.E.	2300	450	IK Vert.
1	100	G.E.	2200	1800	IE-13
1	125	Whse.	550	1140	CS
1	150	Whse.	550	400	CS-594A
2	175/112	G.E.	440	900/720	IK
1	200	G.E.	2200	490	IK
1	200	G.E.	550	580	IK
1	200	G.E.	440	900	IK
1	300	G.E.	440	900	IK
1	300	G.E.	440	600	IK-17B
1	300	Whse.	550	580	CS

SYNCHRONOUS

Qu.	HP	Make	Volts	RPM	Desc.
1	125	Whse.	2200	1800	
1	150	Whse.	4000	1800	dir. con. exctr.
1	225 kva.	G.E.	240	600	ATI-PB
1	400	G.E.	2300	720	TS
1	600	Al. Ch.	2300	720	
2	2100	G.E.	2200/4400	514	ATI

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed	Desc.
1	750	G.E.	220/440	900	ATI
1	900	G.E.	2200/6600	1200	TS
1	1000	G.E.	2300/4100	900	ATI
1	3000	Al. Ch.	2300	900	
1	5000	Whse.	2300/4000	900	

ROTARY CONVERTERS

3 Phase 60 Cycle

Qu.	KW	Make	Speed	DC V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	Whse.	720	250	22000
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
2	300	G.E.	1200	600	2300

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500/225/275/13200/6600
1	500	G.E.	750/225/275/13200/6600

All units can be furnished with AC and DC controls

D.C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	180
1	1200	Whse.	Int.	600	600/720
1	1200	G.E.	MPC	600	450
1	800	G.E.	MPC	550	600
2	625	G.E.	MPC	500	130
1	500	Whse.	Int.	250	250/720
1	500	G.E.	MPC	230	900
1	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	Al. Ch.		230	525
1	250	G.E.	C	230	375
2	200	Whse.	SK	230	400
1	175	Whse.	SK	230	150/525
1	150	G.E.	RC-19	230	800/1000
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625
1	100/150	Whse.	SK-200	550	600
1	100	G.E.	LC-50	230	1200
1	100	Whse.	SK-180	230	600
1	100	G.E.	RC-38	230	600
1	75/100	Whse.	SK-183	230	450/900
1	50/100	G.E.	MPC	230	225/450
2	75	Whse.	SK-188	230	500/1000
1	75	G.E.	C	230	500/1000
1	60	El. Dy.	258	230	525/1050
1	60	Diehl	K-11	230	500/1000
1	60	Al. Ch.	E-131	110	1750
1	50/60	Cr. Wh.	CMC-65H	230	500/1000
1	50	G.E.	RC-19	230	400/1200
1	50	Cr. Wh.	CMC-80H	230	380/750
1	15/50	Cr. Wh.	CMC-81H	230	300/900

SUCCESSFUL OPERATION GUARANTEED
Quality without Question

BELYEA CO., INC.

Main Office and Shop
43 HOWELL ST., JERSEY CITY, N. J.

RE NU BILT BELYEA MOTORS

THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

1—18750 KVA General Electric Cond.
2—15500 KVA Westinghouse Cond.
1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1—3125 KVA Westinghouse Cond.
1— 3125 KVA General Electric Extrac.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 750 KVA General Electric Cond.
1— 625 KVA General Electric Cond.
1— 625 KVA General Electric Non-C.
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

D. C. TURBO UNITS

1—1500 KW General Electric 250 V.
2—1000 KW General Electric 250 V.
1— 125 KW General Electric 125 V.
1— 75 KW General Electric 125 V.
1— 50 KW Gen. Elec.-Terry 125 V.
1— 25 KW Westinghouse 125 V.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 210 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow
1— 94 KVA Ridgway 4-valve
1— 93.8 KVA Skinner Uniflow

D. C. STEAM ENGINE UNITS

1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—250 KW Ames Uniflow 250 V.
1—200 KW Skinner Uniflow 125 V.
1—150 KW Ridgway 4-valve 125/250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Elliott 4-valve 250 V. 3-wire

OIL & GAS ENGINE UNITS—60 Cy.

1—625 HP Worthington, 240 V. gen.
1—610 HP Campbell, 2400 V. gen.
1—520 HP Busch Sulzer, 2400 V. gen.
1—375 HP Worthington, 240 V. gen.
1—300 HP Worthington, 2300 V. gen.
1—300 HP McInt. & Sey., 480 V. gen.
1—283 HP Coop.-Bess., 230 V. gen.
1—175 HP Sterling (gas), 480 V. gen.
3—160 HP Coop.-Bess., 216 V. gen.
1—145 HP Superior, 220 V. gen.
1—125 HP Winton, 240 V. gen.

SURFACE CONDENSER

1—20,000 sq. ft. Worthington
1—12,000 sq. ft. Worthington
1— 5,000 sq. ft. Westinghouse
1— 4,100 sq. ft. Ross

WATER TUBE BOILERS

2—1875 HP B. & W. 285-lb., Stokers
4— 760 HP B. & W. 200-lb., Stokers
1— 750 HP Edge Moor 200-lb.
1— 612 HP Stirling 200-lb.
2— 560 HP Erie City 460-lb.
2— 512 HP Stirling 205-lb.
1— 335 HP B. & W. 200-lb.
2— 300 HP Heine 200-lb.
2— 300 HP B. & W. 160-lb.

A. C. GENERATORS

2—1500 KVA G. E. 25 cy. 2200 V. 750 RPM
2—1250 KVA G. E. 60 cy. 480 V. 750 RPM
1— 750 KVA G. E. 60 cy. 230-460 V. 300 RPM
1— 680 KVA G. E. 25 cy. 13200-4000 V. 300 RPM
1— 500 KVA G. E. 60 cy. 2300 V. 360 RPM
1— 360 KVA West. 60 cy. 240 V. 360 RPM
1— 94 KVA G. E. 60 cy. 2300 V. 600 RPM
1— 48 KW Elec. Mcy. 60 cy. 2400 V. 1200 RPM

SYNCHRONOUS MOTORS

2—1250 HP G. E. 25 cy. 2200 V. 750 RPM
2—1125 HP G. E. 60 cy. 480 V. 720 RPM
1— 850 HP G. E. 25 cy. 13200-4000 V. 300 RPM
1— 770 HP G. E. 60 cy. 230-460 V. 300 RPM
1— 150 HP West. 60 cy. 2200 V. 600 RPM
1—100 HP G. E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

4—3500 HP G. E. slip ring 2300 V. 120 RPM
1—2500 HP G. E. slip ring 6600 V. 253 RPM
1—1500 HP G. E. slip ring 6600 V. 253 RPM
1—1000 HP G. E. sq. cage 2300 V. 509 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
1— 500 HP G. E. slip ring 440 V. 450 RPM
2— 400 HP G. E. slip ring 3800 V. 1800 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
3— 250 HP West. slip ring 2300 V. 720 RPM
1— 100 HP G. E. sq. cage 2200 V. 900 RPM
1— 75 HP G. E. sq. cage 440 V. 514 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.

2—2600 KW General Electric 250 V.
2—2500 KW Westinghouse 250 V.
2—1700 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
2— 750 KW General Electric 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

FREQUENCY CHANGERS

2—12500 KW G. E. 60/25 cy. 300 RPM
2— 5000 KVA West. 25/60 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 2500 KVA West. 25/60 cy. 300 RPM
1— 1875 KVA G. E. 25/60 cy. 300 RPM
2— 1250 KVA G. E. 25/62½ cy. 750 RPM
1— 1250 KVA G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 25/60 cy. 300 RPM
1— 750 KVA G. E. 60/25 cy. 300 RPM

SYN. CONDENSERS—60 Cy.

1—5000 KVA West. 5000 V. 720 RPM
2—1250 KVA G. E. 480 V. 720 RPM
1— 750 KVA G. E. 230-460 V. 300 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.

3— 4000 KVA West. 63.5/110-19/33 KV
4— 2500 KVA G. E. 63.5/110-19/33 KV
3— 2500 KVA Pitts. 66000-25400/12700 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 1250 KVA G. E. 66000-13200 V.
3— 750 KVA Pitts. 66000-33000 V.
3— 333 KVA G. E. 66000-480 V.
3— 1667 KVA G. E. 44000-2300/4000 Y V.
4— 1667 KVA Pitts. 33000-2400 V.
3— 200 KVA G. E. 33000-2300/4000 Y V.
3— 150 KVA G. E. 33000-2300 V.
3— 75 KVA G. E. 33000-13200/11000 V.
1—15000 KVA Al.Ch. 27880-4560 V. 3 ph.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
2— 1000 KVA G. E. 23000/11500-575 V.
3— 667 KVA Packard 23000-440 V.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 250 KVA G. E. 22000-11000 V.
1— 6000 KVA West. 13200-2300 V. 3 ph.
1— 3000 KVA Kuhlman 13800-480 V. 3 ph.
6— 1667 KVA Pitts. 13200-2300 V.
3— 1000 KVA G. E. 13200-2300 V.
3— 200 KVA G. E. 13200-480 V. Pyranol
7— 667 KVA Moloney 11000-2300 V.
3— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3— 1250 KVA G. E. 6600-550 V.
3— 333 KVA G. E. 2300-230/460 V.

VOLTAGE REGULATORS
60 Cycle Induction

6-96 KVA 400 A. 2400 V. Gen. Elec.
1-72 KVA 300 A. 2400 V. Gen. Elec.
2-46 KVA 200 A. 2300 V. West.
6-36 KVA 150 A. 2400 V. Gen. Elec.
6-24 KVA 100 A. 2400 V. Gen. Elec.

OIL CIRCUIT BREAKERS

1— 400 A. 73 KV G. E. FKO36 Outdoor
1— 400 A. 73 KV G. E. FHKO36 Outdoor
6— 400 A. 37 KV G. E. FHKO136 Outdoor
6—1200 A. 34.5 KV G. E. FHKO339 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
2— 400 A. 15 KV. G. E. FHKO136 Outdoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
2—1500 A. 15 KV G. E. FK12 Indoor
6—1200 A. 4.5 KV Condit D-12 Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

TURBO-GENERATORS

A FEW OF THE COMPLETE UNITS NOW IN OUR STOCK

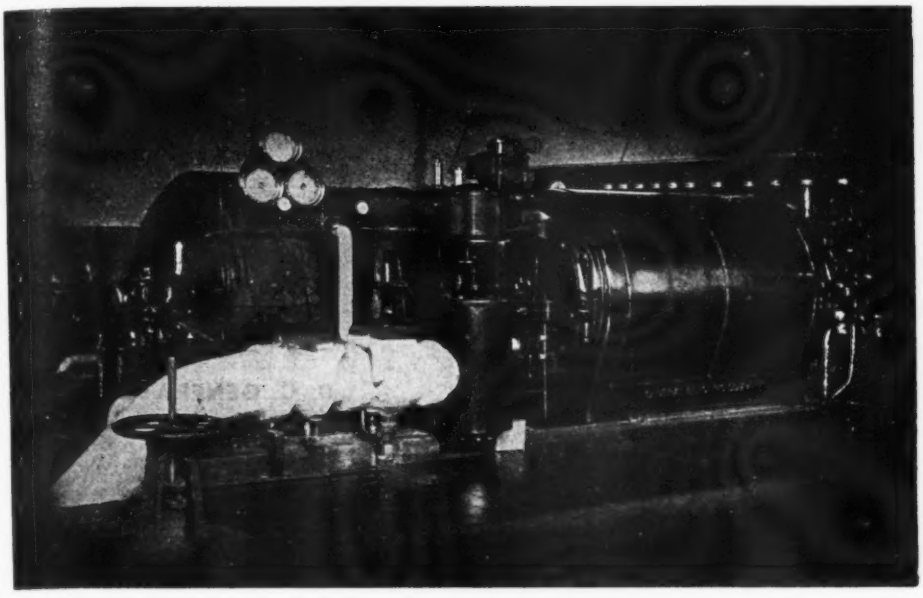
1—6250—KVA. G.E. 3 60 2300V. 200#
1—3125—KVA GE 3 60 2300V. 200#
2—1875—KVA GE 3 60 2300V. 200#
1—1000—KW. DC. West. 250; 135 200#
1—1875—KVA. G.E. Non-Cond.
1—937—KVA GE Automatic Extraction 3 60 2300 V. 200 lbs.
2—937—KVA Allis-Chal. 3 60 2300:200#
1—250—KVA GE. Non-Cond. 3 60 480

Also Any Capacity or Type Desired.

WILMS, WEAVER & COMPANY

PENOBSCOT BLDG. DETROIT 26, MICHIGAN

3125 KVA CONDENSING TURBINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

AVAILABLE IMMEDIATE DELIVERY

3125 KVA — 2500 KW 80% P.F. General Electric, 3 phase, 60 cycle, 2300 volt, 3600 RPM condensing turbine-generator unit, 180-200# I.S.P. 500° T.T., equipped with surface condenser, panels and instruments.

Excellent condition—a complete installation.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

1875 KVA G.E. condensing 175-200 lb. pressure, 500° T.T. 6600 volts, 3600 RPM complete with condenser.

937 KVA Allis-Chalmers condensing 175-200 lb. pressure, 100°, 4000 volts, 3600 RPM with direct connected shaft exciter, condenser and auxiliaries.

937 KVA General Electric condensing 150-175 lb. pressure, 2300 volts, 3600 RPM with direct connected shaft exciter, surface condenser and auxiliaries.

780 KVA Westinghouse non-condensing, 175-200 lb. pressure, 15 lb. back pressure, 480 volts, 3600 RPM, complete with switchboard.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

110 KVA Allis-Chalmers Kerr non-condensing, 125 lbs. pressure, 0-10 lbs. gauge back pressure, 240 volts, 3600 RPM with direct connected exciter.

ENGINE-GENERATOR UNITS

Direct Current

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to a 14" x 18" 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switchboard.

350 KW G.E. 250 volt, 175 RPM generator direct connected to a 28" x 28" Skinner Universal Unaflow non-condensing engine.

125 KW, 125 volt, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lb. pressure, 10 lb. back pressure, complete with switchboard.

75 KW 125 volt, 1800 RPM Westinghouse non-condensing turbine-generator unit.

75 KW, 125 volt, 2400 RPM Allis Chalmers-Terry non-cond. turbine-gen. unit.

15 KW (3) Crocker-Wheeler, 125 volt, 410 RPM generators each direct connected to an American Blower vertical engine.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle
Alternating Current

500 KVA (2) Westinghouse, 440 volts, 164 RPM generators each direct connected to Skinner Unaflow non-condensing engine, 135 to 150 lbs. steam pressure, 5 lb. back pressure.

375 KVA Westinghouse 240 volts, 225 RPM generator direct connected to 440 HP, 4 cylinders Nordberg vertical Diesel engine.

312 KVA Elliot 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westinghouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

200 KVA General Electric 240 volts, 200 RPM generator direct connected to Skinner Unaflow engine—complete.

MOTORS

—3 phase, 60 cycle

125 HP 80% P.F. Elec. Mchy. 440 volts, 400 RPM synchronous.

60 HP G.E. 220 volts. 900 RPM squirrel cage induction complete with starting compensator.

50 HP G.E. type I, form M, 2200 volts, 1200 RPM slip ring

SYN. MOTORS

3 phase, 25 cycle

1700 HP G.E. 2300 volts, 300 RPM.

910 HP Westgh. 2300 volts. 300 RPM.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

150 KW Westinghouse, 250 volts, 1200 RPM generator direct connected to 220 HP 80% P.F., 3 phase, 60 cycle, 440 volt synchronous motor.

FREQUENCY CHANGER SETS

750 KVA Westinghouse, 3 ph., 60-cy., 2300 v. alternating current generator dir. con. to 910 HP. 3 ph., 25 cy., 2300 v., 300 RPM syn. motor.

1200 KVA General Electric, 3 ph., 60 cy., 2400 v. alternating current generator dir. con. to 1700 HP, 3 ph., 25 cy., 2300 v., 300 RPM syn. motor.

SPECIAL OFFERINGS

9375 KVA Westinghouse, 3 phase, 60 cycle, 2300 volt, 1200 RPM alternating current generator.

1250 KVA G.E. 3 phase, 60 cycle, 2300/550/440 volts, 300 RPM alternating current generator.

1690 C.F.M. 110 lb. air pressure Ingersoll-Rand steam driven air compressor 125 to 150 lbs. steam pressure.

1590 C.F.M. 100 lb. air pressure Hardie-Tynes steam driven air compressor 150 to 175 lbs. steam pressure.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

350 GPM, 720' head, 5 stage Allis-Chalmers centrifugal pump direct connected to 125 HP, 3 phase, 60 cycle, 2200 volt, 1750 RPM motor.

22" x 48" Nordberg Corliss belted type engine, 150 to 175 lb. pressure, 100 RPM.

BOILERS

3—410 HP Wickes A.S.M.E. National Code horizontal cross drum box header type water tube boilers, 160 lbs. pressure, complete with stokers and automatic fuel conveyors.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

WAGNER

"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage I-K motor 3-60-2200/4000 V.

50 KW Northwestern rotary converter DC 230 V. input to AC 3 ph. 60 cycle 220 volts 1200 RPM with controls.

35 KW Gen. Elec. CD 115 gen. DC 48 v. 730 amp. coupled to 60 HP G.E. KT 536 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.

30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.

30 KW Hertner gen. DC 125 v. 240 amp. coupled to 47 HP motor 3-60-220/440 v. 1150 RPM, 4 brg. unit.

3—20 KVA Louis Allis Type ONA b.b. rotary converters DC 230 v. to AC 3 ph. 220 v. 60 cycle 1800 RPM.

Many others available—special units built to order

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
100	Gen. Elec.	DLC	230	575
100	Northw'n	interpole	230	1700
75	Whse	813L	230	450
50	National	CS	230	800
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
30	Sprague	dynamom.	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Gen. Elec.	LC	230	1700
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
20	Gen. Elec.	DLC	230	500/1500
20	Fair Morse	TR	230	325/1300
20	Whse.	SK	230	850
15	Gen. Elec.	CD75	230	1750
15	Gen. Elec.	CD83	230	1150
15	Whse. (6)	SK90	230	850
15	Gen. Elec.	CD95	115	575/172

QUICK SHIPMENT FROM STOCK

SEND FOR COMPLETE CATALOG #38A

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	150	Gen. Elec.	I-K	1200
1	150	Gen. Elec. 2200 v.	I-K	1800
1	125	Allis Ch. 2200 v.	AR	1800
1	100	Allis Ch.	AN	1800
1	100	Burke	EM	900
1	75	Whse.	CCL	720
1	75	Gen. Elec.	I-K	600
3	75	Allis Ch. 2200 v.	AR223	1800
1	75	Ideal	A	1200
2	60	Gen. Elec.	KT346	900
1	50	Allis Ch.	AN	1200
1	50	Gen. Elec.	KT542	900
4	50	Allis Ch.	AN	900
1	50	Allis Ch.	AN	720
1	40	Whse.	CX	600
1	40	Gen. Elec.	I-K	1200
2	40	Allis Ch.	AR420	900
1	40	Gen. Elec.	KT342	720
2	40	Gen. Elec.	KT532	1200
2	30	Gen. Elec.	KT326	1200
2	30	Gen. Elec.	KT332	900
2	30	Allis Ch.	AN	1200
1	30	Allis Ch. b.b.	AR220	900
2	30	Allis Ch.	AN	600
6	30	Allis Ch.	AN	900
1	30	Gen. Elec.	K505	600
2	30	Whse. b.b. New	C8405	1800
2	30	Allis Ch.	AN	720
4	25	Allis Ch.	AN	900
3	25	Gen. Elec.	I-K	1200
2	25	Gen. Elec.	KT522	1200
2	25	Allis Ch.	AN	600

25 CYCLE MOTORS

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl.rg.	750
300	Whse.	CW sl.rg.	500
150	Whse.	HF sl.rg.	500
150	Gen. Elec. 2200 v.	MT359 sl.rg.	1500
100	Whse.	CCL sq.cg.	500
100	Gen. Elec.	I-K	750

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	ped.	220/440	900
250	G.E. 1 brg.	ATI	220/440	600
50	Burke		220/440	1200

CENTRIFUGAL PUMPS

14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	HP.	Mfr.	Type	Speed
1	500	Allis Ch. 2200 v.	ANY	514
1	400	G.E. 2200 v.	I-P	1200
1	350	Allis Ch.	ANY	514
1	300	Burke	EMV	225
1	200	Gen. Elec. 2200 v.	I-M	600
2	150	Triumph	SR	514
1	150	Gen. Elec.	I-M	720
1	100	G.E. 2200 v.	I-E13A	1800
1	100	Gen. Elec. 3 brg.	I-M	450
1	75	Gen. Elec.	MT356	900
1	75	G.E. 2200 v.	I-E13	1800
1	75	Gen. Elec.	MT558	600
1	75	Gen. Elec. 2200 v.	I-M	900
1	65	P & H b.b. int.	CA16	900
2	60	Whse. 2200 v.	CW657	1800
3	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Al. Ch. b.b. 2200 v.	ARY	900
1	50	Allis Ch.	ANY	720
1	50	Gen. Elec.	MT342	900
1	50	Gen. Elec.	I-M	600
1	40	Gen. Elec. 2 ph.	MQ536	900
1	40	Northw'n	HW35A	1200
4	40	Gen. Elec.	MT532	1200
2	40	G.E. 2200 v.	MT332	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
250	Northern		250	360
100	Gen. Elec.	DLC	250	700
50	Gen. Elec.	CL	125	875
30	Lincoln b.b. 600 amp.		50	1200
25	Gen. Elec.	CD103	125	1150
19	Gen. Elec. 300 amp.	CD	65	1200
16	Cr. Wheeler	CCD	125	415
15	Whse.	SK63	250	1750

ALSO IN STOCK . . . OIL SWITCHES . . . BLOWERS & FANS . . . SPEED REDUCERS . . . 500 NEW MOTORS

60 CYCLE A. C. GENERATOR

KVA	Mfr.	Type	Volts	Speed
500	Gen. Elec. 3 brg.	ATB	2300	450
300	Allis Ch.		240/480	600
300	Whse.	ped.	240/480	900
250	Gen. Elec.	ATB	240/480	600
200	Gen. Elec.	TRB	240/480	720
125	Whse.	ped.	2300	600
100	Cr. Wheeler		240/480	600
50	Gen. Elec.	ATB	240/480	1200
40	Burke		240/480	1200
30	Gen. Elec.	TAB	240	1800

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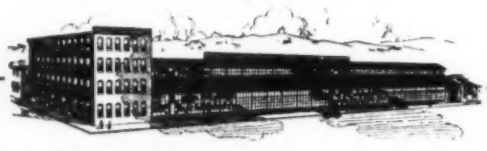

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WATER WHEEL UNIT

1—4250 KVA. Allis Chal. Vertical, 70% PF., 1060 Amp., 3 ph., 60 Cy., 2300 V., 200 RPM. with 4400 B.H.P. turbine 70' head, 200 RPM.

SYNCHRONOUS CONDENSER

1—2500 KVA. Westgh. 3 ph., 60 cy., 2800 V., 720 RPM.

STEAM TURBO UNIT, 60 CYCLE

1—250 K.W. Allis Chal. 3 ph., 60 cy., 2300 V., 3600 RPM. with Kerr, Elliott turbine 150/200# pressure condensing, Mixed Pressure.

STEAM TURBO UNITS, D.C.

1—50 K.W., Gen. Elec. 125 V., Interpole with Terry turbine 3000 RPM. non-condensing.

CONDENSERS

2—935 sq. ft. C. H. Wheeler surface condensers.
1—Schutte & Loertig #38 Low Level Multi-Jet Condenser.

RADOJET AIR PUMP

1—C. H. Wheeler Twin Radojet Air Pump with inner and after condenser, 2 stage type.

BOILER FEED PUMP

1—Cameron 350 GPM at 724' head—125 HP. Gen. Elec. slip ring motor 3 ph., 60 cy., 440 V., 1800 RPM.

TRANSFORMERS, 60 Cy.

3—4000 KVA. Westgh. 1 ph., 63510/110,000Y Vs. Prim.—19050/33000Y Vs. Secy.
3—1667 KVA G.E. 45100/44000/42900/41800/40700 Vs. Prim.—2300/4000Y Vs. Secy.
3—833 KVA. Allis Chal. 1 ph., 36300/33000 Vs. Prim. to 4360/4800 Vs. Secy.

TRANSFORMERS, 25 Cy.

3—2500 KVA. G.E. 1 ph., 110,000/100,000 Vs. Prim.—6600 Vs. Secy.

MOTOR, A.C.

1—1000 HP. Gen. Elec. Mill type, squirrel cage, 3 ph., 60 cy., 2300 V., 514 RPM.

ARCHER & BALDWIN, INC.

75 West St., New York City
Tel. BOWling Green 9-9275-9276

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
5	G.E.	440	1200	MT
20	Westg.	220	1735	CW
50	Westg.	440	1145	HF
50	Chandeys'n	220/440	1800	
50	Allis Chal.	220	490	
54	Allis Chal.	440	900	
75	G.E.	440	1200	I-M
75	West.	220/440/2200	580/290	CW
100	West.	220/440	685	CW
150/75	West.	220/440/2200	580/290	CW
150	West.	2200	375	CW
150	West.	2300	490	CW
150	West.	220/440	490	CW
185		2300	900	
250	Burke	440	600	EMV-65
300	G.E.	440	900	I
300		2300	720	
400	Westg.	2300	580	CW
400	Westg.	2200	435	CW-1214
1500	Westg.	2200	435	CW

ALTERNATING CURRENT MOTORS

3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
25	West.	220/440/550	1200	CS
25	G.E.	220/400	580	KF
30	G.E.	440	1800	KT
30	Line. Elec.	220	600	
30	Duquesne	440	600	
30	Triumph	220	525	TR-138
30	Allis Chal.	220/440	1200	
35	Lincoln	220	720	
40	Howell	220	900	SO
40	Line. Elec.	220	900	
40	G.E.	220/400	900	KF
40	Duquesne	220/440	850	
40	G.E.	440	1800	KT-527-4
50	Fair Morse	220	900	
50/150	West.	2200	360/720	CS-954
50	West. El.	220	570	KT-346
50	Chandeys.	220/440	1800	
50	Cr. Wh.	240/480	1200	Syn.
50	Duquesne	440	1200	
50	Allis Chal.	440	1800	AN
50	G.E.	220/440	1200	HI
50/32	G.E.	440	800/640	
60	Duquesne	440	1800	
75	Louis Allis	220/440	1770	505Y
	Adjusto speed—splash proof—ball bearing			
75	West.	2200/220/440	720	CS
75	West.	2300	1200	Syn.
100	Allis Chal.	220	1750	
100	Allis Chal.	220	600	
100	G.E.	440	400	I-K
125	West.	2300	1170	CS
150	New Amer.	480	720	Syn.
150	West.	220/440	327	Syn.
150	Wagner	440	1800	31V
150	G.E.	2200/220/440	450/243	
50/100	West.	2200/440/220	360/720	CS
	(Complete with Niles Speed Reducer, ratio 10:1)			
175	G.E.	2200	600	I-12
200	Westg.	440	1700	CS
200	Westg.	2200	900	
200	G.E.	220/550	514	I
400	West.	2200/220/440	500	CS
1000	G.E.	2300	509	K
1500	G.E.	2200/220/440	225	ATI-Syn.
3500/4000	West.	4000/23000	900	Syn.

VARIABLE SPEED MOTORS—230 VOLT D.C.

H.P.	Make	R.P.M.	Type
2¼	Westg.	450/900	SK-30
2½	G.E.	500/1000	RLC
2½	Reliance	500/1000	14T
2¾	Westg.	900/1800	SK
3	Jantz-Lieat	650/1950	BI-DC
3	Roth (Enclosed)	500/1000	R8
3¼	West.	400/1600	SA
3½	Westg.	850/1700	
3½	Reliance	300/600	
5	Reliance	300/1800	21
7½	Westg.	450/900	80L
7½	Reliance	650/1300	550v.
7½	Westg.	1125/2905	SK-43
7½	West.	400/1600	SA
10	Westg.	565/1130	S-6
10	G.E.	625/1250	LC
10	West.	400/1600	SA
15	Louis Allis	1150/1750	NA
15	Reliance	500/1800	
15	West.	675/1350	SK-100L
20	G.E.	270/540	
20	Westg.	750/1500	SK-110L
20	Westg.	750/1125	SK
30	G.E.	450/900	RLC
35	G.E.	375/1400	IC
50	G.E.	600/1200	500 v.
75	West.	475/950	SK-180
75	West.	400/650	SK-181

TRANSFORMERS—1 ph. 60 cy.

No.	KVA	Pri.	Sec.	Make
1	2	6600	110/220	G.E.
3	5	2300	220/440	G.E.
1	5	550	110	Pgh.
1	5	2200	110/220	West.
84	7½	2200	220/110	G.E.
32	7½	2200	220/110	West.
12	10	2200	220/110	West.
13	10	2200	220/110	G.E.
2	15	400/30000/50000		American
1	25	2200	220/110	G.E.
6	35	220	110	West.
3	37½	2200	440/220	West.
3	50	6600	575/440/220	G.E.
2	50	6600	550/440	Pgh.
2	50	6600	550/440	Al. Ch.
6	73	2200/4000	220/110	West.
6	73	440	205	West.
1	75	2200	220	Burke
6	75	2200	220/440	West.
3	150	2400	240/480	Allis Chal.

INDUSTRIAL TRUCKS

1—Baker Tow Truck with batteries.
1—4000 lbs. Automatic Lift Truck, 50" lift. Platform is 26" x 51½". Overall length of truck 115".

HOIST

1—3 ton Westinghouse Hoist with Westinghouse DC Motor, 1600 rpm.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari-time magnetic controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS

250 Volts Compound Wound, D. C.—3 Ph., 60 cy. Motors

KW	Make	RPM	AC volts
2	Crocker Wheeler	1750	220/440
3	Westinghouse	1150	220/440
5	Allis Chalmers	1150	220/440
7½	Allis Chalmers	1150	220/440
10	General Electric	1150	220/440
15	Westinghouse	1150	220/440
20	Westinghouse	1150	220/440
25	Westinghouse	1150	220/440/55
35	G.E.	1150	220/440
35	Westinghouse	850	220/440
40	West.	1150	220/440
150	West.	900	220/440 syn.

1—100 kw. 125 v. DC West. Gen. with 2300 v. 3 ph. 60 cy. 1200 rpm. West. Motor including starting equipment and DC switchboard.
1—100 kw. 250/275 v. DC G.E. Gen. dir. driven thru coupling by 1—150 HP 2200 v. 900 rpm. G.E. Syn. Motor.
1—200 kw. West. 600 v. DC 900 rpm. Generator direct driven through common shaft by 1—290 HP 440 v. 3 ph. 60 cy. Westg. Syn. Motor.

A.C. GENERATORS

62½ KW Westg. 3 ph. 60 cy. 240/440/2300 v. 1200 rpm.
125 KVA New American Electric 480 v. 720 rpm type OG-56.
250 KW Al. Ch., 480 v., 150 rpm. 3-ph.
360 KVA West. 220 v., 3 ph. 60 cy., 360 rpm.

SPEED REDUCERS

1—36 HP Cleveland Model 150, size 900 AT, ratio 43:1.
1—40 HP W. A. Jones 480 rpm. ratio 9.143:1.
2—50 HP W. A. Jones 575 rpm. ratio 9.143:1.
1—75 HP W. A. Jones 875 rpm. ratio 9.143:1.
1—100 HP W. A. Jones 1150 rpm. ratio 9.143:1.
1—125 HP Nuttal, single reduction, ratio 1.6:1 450 rpm.
1—150 HP Nuttal, single reduction, ratio 1.6:1.
1—175 HP Jones 1750 rpm. ratio 9.143:1.
2—180 HP Cleveland size 1000 AT ratio 9-2/5:1.
1—225 Nuttal, ratio 1.6:1.
1—300 HP Nuttal, ratio 1.6:1.
1—400 HP Nuttal, ratio 1.6:1.

Large Stock—CIRCUIT BREAKERS—METERS—CURRENT AND POTENTIAL TRANSFORMERS — POTHEADS — RELAYS — METERS — SAFETY SWITCHES — DISCONNECT SWITCHES — U-RE-LITES — PULLEYS — REACTORS.

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DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH 6, PA.

STEAM PUMPING ENGINES

1—Snow 8 MGD C&FW cr. Com. Opp. Type Cond. 26x54x17x36, with waterworks type condenser.
1—Snow 6 mgd. C&FW Cr. Com. Opp. Type Cond. 20-40x14¾x36, with waterworks type cond.
1—Allis-Chal. 4 mgd. cr. com. cond. Size 12x28x13x24. All fine cond.
1—Platt Iron Wks. Cr. Comp. C&FW Meyer Valve Gear Cond. 1000 GPM. Size 14x28x9¼"x18.

PUMP VALVES

Birch Valves for all types of reciprocating pumps.

LARGE GATE VALVES

1—20" Rensselaer #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod and Eyebolt, 100#.

BIRCH MANUFACTURING COMPANY

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STATION M Since 1912 CINCINNATI 27, OHIO

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR GENERATOR SETS

KW	Make	DC	Volts	AC Volts
1500	Wtg.	250	Syn.	3/60/2300
1200	G.E.	280	Syn.	3/60/4100
1000	G.E.	250	Syn.	3/60/4150
1000	G.E.	600	Syn.	3/60/2300
1000	Wtg.	275	Ind.	3/60/4100
750	Wtg.	275	Syn.	3/60/440
235	Wtg.	125	Syn.	3/60/2200
225	Ideal	125	Syn.	3/60/2200
200	Elliott	125	Ind.	3/60/2200
150	Al. Ch.	250	Syn.	3/60/2300
100	Al. Ch.	125	Syn.	3/60/440
100	Wtg.	250	Ind.	3/60/440
100	Wtg.	250	Ind.	3/60/2200
100	G.E.	250	Ind.	3/60/2200
75	G.E.	250	Ind.	3/60/440
75	G.E.	125	Syn.	3/60/220
60	Al. Ch.	110	Ind-	3/60/2200
50	G.E.	250	Ind.	3/60/440
25	G.E.	230	Ind.	3/60/220
22½	G.E.	125	Ind.	3/60/220
15	Ideal	220	Ind.	3/60/220
10	G.E. 115/230			Balancer set
7½	G.E.	60	Ind.	3/60/440
7½	Jen. 115/230			Balancer set
5	Roth 125/250			Balancer set
3½	G.E.	230	Ind	3/60/220
3	Lincoln	115	Ind.	1/60/220
3	Lincoln	115	Ind.	1/60/220
3	Westg.	25	Ind.	3/60/220
2½	Acme	45	Ind.	3/60/220
2¼	Wotton		Ind.	1/60/110/220
2.4	Lincoln	80	Ind.	3/60/220
3 HP	Roth	110	2 KVA	1/60/110
2	El Sp.	750	Ind.	3/60/440
1	Holtz. C	65		220 D.C.
.5	Rob. M.	115		Variable voltage
.378	G.E.	110	Ind.	1/60/110
.250	Robbins	125	Ind.	1/60/125
.250	Roch.	120	Ind.	1/60/110/220
.2	G.E.	6		115 v. d.c.
.2	G.E.	6	Ind.	1/60/110/220

FREQUENCY CHANGERS

1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph., 60 cy., 460 volt, 300 RPM, 1570 amps., 1250 KVA, 0.9 P.F. 50° synchronous motor with amort. wdg.; dir./conn. to 1000 KW General Electric type ATI-10-1250M-300, 3 ph., 25 cy., 460 volts, 300 RPM, 1570 amps., 1250 KVA, 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

40 KW Howell, SR-5454, 3 phase, 60 cycle, 440 volt to 40 HP 3 phase, 25 cycle, 40 volt, SC-443, .8 p.f., 750 GM, 4-brg. set.

SLIPRING MOTORS
3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
2	2500	G.E.	MT	253
1	1000	Westg.	CW	450
1	1000	Westg.	HR	360
1	1000	G.E.		400
1	850	Allis. Chal.		1180
1	800	Westg.	CW	360
2	800	Westg.	CW	507
1	800	Westg.	CW	900
1	750	Allis. Ch.		440
1	750	G.E.	I-P	900
1	700	G.E.	MT-10	710
1	600	Westg. with drive		350
1	600	Westg.	CW	390
1	500	G.E.	MT412	435
1	500	G.E.	MT412	450
1	450	G.E.	MT412	600
1	400	Westg.	CW	435
1	400	Allis Chal.		600
1	400	G.E.	I-M	720
1	400	G.E.		1200
1	400	G.E.	IP	1800
1	350	Allis Chal.		300
1	350	G.E.	MT	300
1	350	G.E.	I-M	900
1	300	G.E.	I-24	293
1	300	Westg.	CW	400
1	300	G.E.	I-P	450
1	300	G.E.	MT-410	450
1	300	Westg.	CW	500
1	300	G.E.	I	514
1	300	G.E.		720
1	250	Westg.	CW	435
1	250	Cr. Wheeler	SR27QB	600
1	250	G.E.	IM	435

SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
1	1000	G.E. 2200 v.	K	509
1	700	G.E. 2200 drip-proof cons.	KF	1800
1	600	Fair. Morse	H2	212
1	500	G.E.	IK	1200
1	500	Westg.	CS	1750
1	400	Allis. Chal.		600
1	400	G.E.	I-M	950
1	400	G.E.	I-K	1800
3	250	Westg.	CS	350
1	250	Ideal	A	1200
4	250	Fair. Morse	BB	1800
1	225	G.E.	I-E	1800
1	225	G.E.	FT	3600
1	200	Allis Chal.	AN	347
1	200	Fair. More		514
1	200	Westg.	CS	600
1	200	G.E.	IK	600
1	200	G.E.	KT566	720
3	200	G.E. 2200 v.		1800
3	200	Fair. Morse	BB	1800
1	200	Westg.	CS	3600
2	200	G.E.	KTP	3600
1	150	Allis Chal.		570
1	150	G.E.	IK	600
1	150	Westg.	CS	1800
2	120	G.E.		720
2	150	G.E.	I-K	720
1	150	Allis Ch.		850
1	150	G.E.	K-558	900
1	150	Westg.	CS	1800
4	125	G.E.	KT	720

TRANSFORMERS

No.	KVA	Make	Type	Pri.	Sec.
2	200	G.E. 3 ph. Auto.	HT	4000Y	2300Y
1	100	G.E. 3 ph. 25 cy.	HT	9000	230
1	75	Daring Auto	H. 182	10	250
2	75	West. S		3810	244/122
3	75	West. SK		3810	244/122
1	30	Kuhlman 3 ph.		210/220/230	55/100
1	15	Ft. W. A.		1050/2100	2200/288
1	10	Moloney HE		1100/2200	220/440
1	7½	G.E.	H	1100/2200	244/488
1	7½	G.E. 3 ph.	HT	2300/3810	220/440
1	7½	Pitts.	HE	2200	110/220
1	7½	G.E. 3 ph	HT	6600	230
1	6	Sorgel 3 ph.	SO	140	228
1	5	G.E.	H	1100/2200	220/440
1	3	Moloney	HE	2200	110/220
1	3	Moloney	HE	1150	115/230
8	3	G.E.	H	220/440	55/110
1	1½	Al. Ch.		2200	110/220

BOILER

300 HP Kesler, reinsurable 200 lbs. with chain grate stoker, can release at once.

3—100 KVA New Moloney, type CL, single phase, 60 cycle, 33000 volts primary, 480/220 volts secondary.

TURBINE

100 HP Terry steam turbine, 125 lbs. for 3 phase, 60 cycle, 240 volt operation, 3600 RPM, fine condition.

Have large stock other sizes and speeds. Motors, Generators, Pumps, Transformers. NEW factory distributors, can furnish many new items from stock.

CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO 8, ILL.

M-G Sets 3 ph. 60 cy. (Syn.)

500 KW G.E. 250 v. end. wd. Gen. with interpoles, 900 RPM direct coupled to a G.E. Syn. 40% Leading P.F. Motor 2300/3/60 900 RPM with AC and DC Panels.

150 KW G.E. 250 v. cpd. wd. Gen. with interpoles, 900 RPM direct con. to 225 HP. G.E. Syn. Motor Type ATI 2300/3/60 900 RPM. with AC and DC Panels.

100 KW West. 125 v. Type SK 170L cpd. wd. Gen. with interpoles, 1200 RPM. dir. con. to 150 HP. West. Syn. Motor 2300/3/60 1200 RPM. with AC and DC Panels.

100 KW Ridgway 250/275 v. DC Gen. cpd. wd. with interpoles, 1200 RPM. dir. con. to 150 HP. Ridgway Syn. Motor 2300/3/60 1200 RPM. with AC and DC Panels.

50 KW. G.E. Type BR 125/150 v. 1750 RPM. dir. con. to 75 HP. G.E. KT 220/440 v. 3 ph. 60 cy. 1800 RPM. with starting equipment.

CAPACITOR

180 KVA General Electric, 2300/3/60 Type OH 1.

SYN. CONDENSER

5000 KVA Westinghouse 4000/2300/3/60 900 RPM with dir. con. exciter (Late Type).

WELDING M.G. SETS

150 amp. Lincoln with 220/440 v. Motor.
300 amp. Lincoln Stable Arc with 440 v. Motor.
400 amp Lincoln Stable Arc with 440 v. Motor.
600 amp Lincoln Shield Arc with 440 v. Motor.

AC & DC GENERATORS

160 KW G.E. AC 2300/440/220 v. 3 ph. 60 cy. 720 RPM.
150 KW West. 250 v. 450 RPM Type S cp. wd.
100 KW West. Type SK 250 v. 900 RPM.
90 KW G.E. Type CL 250 v. 1000 RPM.
75 KW G.E. Type DLC 125 v. 700 RPM.
50 KW G.E. Type BR 150 v. 1750 RPM.

AC & DC STEAM ENGINE GENERATOR SETS

50 KW West. 125 v. 300 RPM cp. wd. dir. con. Skinner R.H. Engine.
75 KW G.E. 125 v. 275 RPM cp. wd. dir. con. to Skinner Center Crank Engine.
100 KW West. 250 v. 250 RPM cp. wd. dir. con. to Skinner Engine.
150 KW Cr. Wh. 3 wire 125/250 v. Skinner Universal Unaflow Engine.
160 KW G.E. 240/480 v. 3 ph. 60 cy. Gen. dir. con. to Nordberg Engine.
200 KW Cr. Wh. 3 wire 125/250 v. Ames Una-Flow Engine.

STEAM TURBINES

2—1 KW Frick & Lindsay 110 v. DC.
67½ KVA Al. Ch. 220/3/60 3600 RPM Gen. with 80 HP. Kerr Turbine.

ROLLING MILL DRIVE

500 HP G.E. Type MT 412 slip ring 2300/3/60 435 RPM 3 bearing with starting equipment including Morse Chain Drive 84" centers, ratio 4.28 to 1, motor sprocket 25 Teeth, 14" face, 7" bore, 2" pitch, large split sprocket, 107 Teeth, 14" bore, including oil tight steel enclosure and oil pump.

AC MOTORS 3 ph. 60 cy.

HP	Make	Type	Speed	V.
	Syn.			
200	West.	8 P. F.	900	2300
150	West.	ATI 8 P.F	900	2300
	Each with dir. con. exciter.			

Slip ring

1500	West.	CW	435	2200
500	G.E.	MT 412	450	2200 v. 3 brg
300	West.	CW	495	2200
200	G.E.	IM	514	2200
200	G.E.	MT 412	240	2200
150/75	West.	CW	580/290	2200/220/440
150	West.	CW	580	2200/220/440
150	West.	CW	375	2200/440/220
125	Al. Ch.		435	2200
100	Al. Ch.		575	2200
100	G.E. (25 cy.)	MI 108	500	220/440
75	West.	CW	290	2200/220/440
75	West.	CW	580	2200/220/440
50/12½	G.E.	IM	450/900	2200
50	G.E.	IM	900	2200
37	Otis	Int. rated	1140	220/440
30	F. M.	B. brg.	1200	220/440
20	West.	CI 556	900	220/440
15	G.E.		900	220/440

Squirrel Cage

1000	G.E.	KT	514	2200
150(2)	West.	CCL	600	220/440
100	G.E.	IK	1200	220/440
100	West.	CS	580	220/440
75	West.	CCL	900	220/440
50	Triumph	B	720	220/440
40	Elliott		1200	220/440
30	Al. Ch.		1200	220/440
30	Al. Ch.		860	220/440
25(2)	West.	CCL	845	220/440
25/7½	Cr. Wh.	119 AQ	1170/585	2200
20	West.	CCL	1120	220/440
20	West.	CS 405	850	220/440

Reduction Units

2—5 HP Aetna Gear Drive Ratio 12 to 1.
25 HP Morse Silent Chain Drive.
50 HP Morse Silent Chain Drive.
150 HP Nuttal Ratio 1.6 to 1.
250 HP Ottumwa Ratio 12.7 to 1.

500/700 HP Morse Chain Reduction 84" centers 25 Tooth motor sprocket 14" wide, 2" pitch, 7" bore, large split sprocket 107 Teeth, 14" bore, including oil tight steel enclosure and oil pump.

DC MOTORS

Series Wound

HP	Make	Type	Speed	Voltage
2½	Niles	6 x 4	600	110
10	Niles	7 x 5	600	110
60	G.E.	CO 2507	600	230
100	G.E.	MD 108	480	230
130	G.E.	CO 1812 A	550	230
175	G.E.	MD 109½	475	230

Variable Speed

5 (2)	Reliance		500/1500	230
	with Aetna Gear Drive.			
6½	G.E.	RC 26A	2500/3125	110
7½	West.	SK 100	500/1500	500
10	West.	S 6	565/1130	230
10	G.E.	RLC	400/1200	230
10	Cr. Wh.	CM	500/1500	230
20	Cr. Wh.	CCM	600/1200	230
25	West.	SK 130	600/1200	230

Constant Speed

15 (2)	West.	SK 100L	675	230
15	West.	M	650	110
20	West.	SK 100L	850	230
20	Northern		650	110
20	West.	SK 110L	750	230
25	Reliance	185 T	850	230
25	West.	SK 130	600	230
100	G.E.	DLC	575	110
175	West.	S	320	230
105	G.E.	CL	700	230

AIR COMPRESSORS

1—355 cp. ft. 100# pre. Ing. Rd. Type ER 1, plate valve, 12" bore 10" stroke, with idlers. Equipped with either AC or DC Motor.
492 cu. ft. Chic. Pneu. simplate valve Type NS03 straight line, 16½" & 11"x18" 100# pres.

Transformers

Qu.	Kva.	Make	Ph.	P.V.	S.V.
3	50	G.E.	1	22000/2300	
1	37½	West.	1	2300	160/230/115
2	25	G.E.	1	2300	244/488
1	25	Al. Ch.	1	2200	220/440
30	10	West. & G. E.	1	2200	122/244
27	7½	West. & G. E.	1	2200	122/244

MOORHEAD-REITMEYER CO., INC.
PITTSBURGH 19, PA.

TURBO GENERATORS

1—937KVA Gen. Elec. with Wheeler condensor

1—500KW Allis Chalmers Moore non-cond.

1—500KW Gen. Elec. non-cond.

1—300KW Gen. Elec. cond.

ROTARY CONVERTERS

1—1500KW 250V Westgh complete

2—1000KW 250V Westgh complete

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, transformers, Circuit Breakers, etc. Please send us your inquiries.

What have you for sale?

KEYSTONE
Power Plant Equipment Company

8403 Hegerman St., Phila. 36, Penna.

COMPRESSORS
526 CFM Ingersoll Rand, Style "J"
940 CFM Ingersoll Rand, Type 10 hor. 2 st. steam driven, with receiver

CRUSHERS
24" x 54" Superior Crushing Rolls
No. 3 and No. 6 McCully Crushers

HOISTS & HOIST MOTORS
(Write for our complete list!)

SHOVELS
#2 Koehring 3-way comb. Crane, Dragline & Shovel
320-B 6½-yd. Electric Stripping

TRACTOR WAGONS
7, 7½ yd. cap. Allis Chalmers Speed-Ace Tractor Wagons

—— Request bulletin! ——

TANK AND TOWER
60,000 gallon Water Tank on 89'9" tower, with 10" riser pipe.

IRON & STEEL PRODUCTS, INC.
13438 S. Brainard Ave., Chicago 33, Illinois.
"ANYTHING containing IRON or STEEL"

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NEW and USED

All makes & sizes for prompt shipment

We have an extensive list of good Used Boilers available . . . let us have your Inquiries.

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122 S. Michigan Ave. CHICAGO

COMPRESSORS
Over 150 in stock
New and Guaranteed Rebuilt
Modern Plant doing Modern Rebuilding
From 50 CFM to 2500 CFM
AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 48th St., North Bergen, N. J.

1—440 HP Elec. Machinery, 3-60-440V, 900 RPM, two bearing syn. motor

1—400 HP Westinghouse, type CW, 3 ph. 60 cy. 440V, 450 RPM slip ring motor

1—300 HP General Electric, 3 phase, 60 cycle, 440 volt, 360 RPM, type MT 412 slip ring motor

1—1275 HP, Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1175 RPM slip ring motor

1—200 HP, Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1150 RPM slip ring motor

1—150 HP, General Electric, 3-60-400V frames 17A 360 RPM slip ring

1—150 HP Westinghouse, 2 ph, 60 cy, 440V frame 1000, CW, 390 RPM slip ring

1—100 HP General Electric, 3-60-440V, 495 RPM, MT 562 slip ring

2—100 HP General Electric, type I, form K, 3-60-220V 575 RPM

2—800 HP, 3 PH, 60 CY, 6600 V Westinghouse, type CW, slip ring 507 RPM mill type motors with liquid slip regulators.

1—150 HP DC Westinghouse type SK, frame 666.3, 600 V. 360/720 RPM ped. type mill motor, #4798360.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200 V, 1750 RPM, Squirrel Cage

1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 580 RPM slip ring

1—100 HP General Electric, 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter

2—100 HP Crocker Wheeler, size 2AQ, 3 ph, 60 cy, 440V, 385 RPM slip ring

1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage.

4—75 HP, G. E. 3-60-2300V, 400 RPM, type I, sq. cage

1—75 HP, General Electric, 3 phase, 60 cycle, 440 volt, 450 RPM, type I, form M, slip ring motor

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring

1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage

1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring

2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors

1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage, 900 RPM

1—G.E. factory built syn. M-G set 230 KW, 125 V, 600 RPM generator driven by 335 HP, 4600 V syn. motor complete with starting equipment and panels.

1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K

1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring

1—60 HP General Electric, 3 phase, 60 cycle, 440 volt, 600 RPM, type MT 556 slip ring motor

1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring

1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound

1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring

1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage

2—50 HP Allis-Chalmers, 3-60-440V, 890 RPM slip ring

1—50 KW, Allis-Chalmers, factory-built, 3 bearing M-G set, 125 volt DC, driven by 75 HP, 3 phase, 60 cycle, 220 volt, 1165 RPM motor

1—50 HP General Electric 3-60-440V, 690 RPM, MT 546, slip ring

1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring

1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage

1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage

1—50 HP General Electric, 3-60-440V, 490 RPM, type I-M, slip ring

1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM Sq. Cage

1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring

1—45 KVA Fairbanks-Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator

2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 12B ball bearing

2—drag generators, 15 KW. Westinghouse, SK111, 125 V. 450/1800 RPM gear head, ratio 10 to 1, used a few months.

2—175 HP, 230V, DC Westinghouse, type SK, 150 to 550 RPM

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM

1—60 HP Westinghouse, type SK140L, 115V, 1150 RPM vertical

1—50 HP Westinghouse SK200, 230V, 250/900 RPM

2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25 cy-440V, 720 RPM, type MS, Sq. Cage

1—50 HP General Electric, 3-25 cy-440V, 700 RPM, type I-M, slip ring

1—40 HP Westinghouse 3-25 cy-440V, 730 RPM, type CI, frame 753A slip ring crane

1—35 HP Allis-Chalmers 3-25 cy-440V, 720 RPM, slip ring

1—30 HP Westinghouse 3-25 cy-440V, 720 RPM, CS, Sq. Cage

The Wente Electric Co.

Hamilton, Ohio

REBUILT MOTORS & GENERATORS SINCE 1906

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

6250 KVA G.E., 2300 V., cond.
3750 KVA Wghse. 600 V. BLEEDER.
3125 KVA G.E., 4100/2300 V. cond.
3125 KVA G.E., 480 V., BLEEDER.
2500 KVA G.E., 2300 V. cond.
2500 KVA Al. Chal. 440 V. cond.
1875 KVA G.E., 2300 V. cond.
1553 KVA Al. Chal. 480 v. Cond.
1250 KVA (2) G.E., 2300 V. cond.
780 KVA G.E., 2300 v. Cond.
625 KVA Wghse. 2300 V. cond.
375 KVA G.E., 2300 V. cond.
312 KVA Elliott 480 v. cond.
250 KVA Al. Chal.-Elliott Kerr, 240 v.
150 KVA Wghse. 240 V. cond.

(NON COND.)

500 KVA Wghse. 480/240 V.
375 KVA G.E., 2300 V.
312 KVA C.W.—Moore, 450#, 240 V.
280 KVA E.M.-Terry.
75 KVA Al. Chal. 240 V.
190 HP Wghse. 375# Turbine.
150 HP Terry. 225# Turbine.

BOILERS

850 HP B&W W. T. Boiler 250# with Riley Stoker.
749 HP (2) Edgemoor, 200#
728 HP Erie City, Ver. 200#
612 HP Sterling 250# Chain Gr. Stoker.
522 HP Kidwell 207#, 3 drum.
471 HP Erie City Ver., 160#
396 HP B. & W., 160#
300 HP (2) Union Iron Wks. Cross drum 175#
287 HP (2) B&W 160#
259 HP (3) Wicks ver.; 160# pulverizers.
255 HP Casey-Hedges 160#
Two 78" x 18' HRT 125# pulverizers.

DIESEL ENGINE SETS

375 KVA Wghse.—Busch Sulzer
312 KVA G.E.—Anderson
312 KVA G.E.—McIntosh Sey.
300 KVA Fairbanks-Morse "VA"
200 KVA G.E.—Busch Sulzer.
118 KVA (2) Fairbanks 32E12.
125 KVA Ideal-Primm
105 KVA Ideal-Primm.
100 KVA C.W. Bessemer
90 KVA (4) F.M.—F.M. "VA"
75 KVA Al. Chal.—International

DIESEL ENGINES

225 HP Chicago pneumatic 6 cyl.
80 HP (3) Fairbanks Style V. A.

SPECIAL

780 KVA G.E. 3/60/2300 v. Turbo Unit. 4 stage.
250 KVA G.E. 3/60/240 v.—Nordberg UNIFLOW Engine.
250 KVA Al. Chal. 3/60/240 v.—Elliott Kerr Turbo, non-cond.

STEAM ENGINE SETS (A C)

675 KVA Burke—24 x 36 Norberg Unif.
480 KVA Al. Chal.—Corliss 4 V.
375 KVA G.E.—22 x 27 Erie Ball, 4 V.
325 KVA A.C.—21 x 22 Skinner-Unif.
300 KVA G.E.—Ames UNIFLOW (Twin)
250 KVA G.E.—Nordberg UNIFLOW.
175 KVA Wghse.—Ames UNIFLOW.
150 KVA G.E.—16 x 16 Skinner S.V.

PUMPS (MOTOR DRIVEN)

8000 GPM Al. Chal. 132' head.
7500 GPM 80' head.
5500 GPM Buffalo 50' head.
3600 GPM 85' head.
3250 GPM 425' head.
3000 GPM 100' head.
3000 GPM (2) 65' head.
1200 GPM Al. Chal. 65' head.
1000 GPM Morris 255' head.
725 GPM Wheeler 30' head.
350 GPM 720' head.

STEAM ENGINE SETS 250 V.

450 KW C. W.—Nordberg Unif.
400 KW G.E.—Ridgway 4 V.
300 KW G.E.—Skinner Unif.
250 KW C.W.—Skinner UNIFLOW.
150 KW G.E.—Erie Ball 4 V.
100 KW G.E.—Erie Ball 4 V.

AIR COMPRESSORS

2200 CFM Nordberg 100#, Steam and Motor Driven.
1000 CFM Nordberg 85#—Motor.
1080 CFM Nordberg, 100#—Motor.
500 CFM Ingersol 100#

SYNCHRONOUS CONDENSER

5000 KVA Wghse. 3-60-2300/4000 V. 900 RPM, with starting apparatus.

GAS ENGINE UNIT

1000 KVA G.E. 3-60 2300 v.—1200 HP. Rathburn Jones Gas Engine.

POWER PLANT EQUIPMENT

GENERATORS

One 250 K.V.A. and one 300 K.V.A. Crocker Wheeler Generators direct connected to Skinner Tandem Compound Engines 480 Volts — 3 Phase — 60 Cycle — Switchboard

One 300 K.W. General Electric Generator 2300 Volts—3 Phase—60 Cycle Direct connected to Curtis Steam Turbine 175 lb. pressure — 3600 R.P.M. with I.S.K.W.G.E. Direct Connected Exciter

BOILERS

One 444 H.P. Union Iron Works Steam Boiler 200 lb. pressure—pulverized coal or oil fired

One 50 H.P. Erie City Economic Steam Boiler 100 lb. pressure, coal or oil fired

PUMPS

One Quimby 4 Stage Centrifugal Pump Direct connected to 75 H.P. G. E. Motor 220 Volts 60 cycle, 3 Phase, 1750 R.P.M. 500 G.P.M. 150 lb. pressure

One American Well 2 Stage Centrifugal Pump direct connected to 30 H.P. G. E. Motor 220 Volts, 60 cycle, 3 phase 1750 R.P.M. 350 G.P.M. 200 ft. head

FEED WATER HEATERS

One Goubert Feed Water Heater Brass tubes—330 Sq. ft. heating surface

One Cochrane Feed Water Heater 54" Dia. x 48" Long — 1000 H.P. Capacity

EMSCO EQUIPMENT CO.

EMIL A. SCHROTH, Owner

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POWER PLANT EQUIPMENT

TURBO GENERATORS

2—10,000 K.W. Westinghouse 6600 or 2300 V. Complete with condensers, switchgear and all other auxiliaries.

BOILERS

5—760 H.P. B & W, forged steel heads, 225# pressure A.S.M.E. and National Board superheaters, stokers and complete auxiliaries.

6—500 H.P. BW—200# pressure, steel headers, with stokers and superheaters. Conditions excellent, ready to operate.

TRANSFORMERS

UP TO 5000 KVA

3—2500 KVA.
9—300 KVA.
3—500 KVA.
Number of smaller sizes.

We buy complete plants outright!

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HOWE BROTHERS

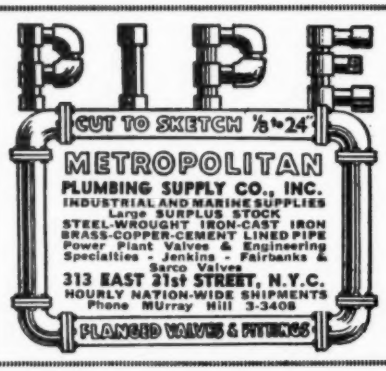
324-328 Pearl St. New York, N. Y.
TEL. WORTH 2-2708-2709-2710

GOOD VALUES—ALWAYS

PD 30 International Diesel Power Unit.
2—300 HP Fairbanks Morse Oil Engines.
300 HP 250 KVA McIntosh Seymour Die.
300 KW 440 HP Nordberg Diesel Generator.
375 and 500 HP Fulton Diesel Generators.
800 KW Gas Engine Generator Set.
2—80 HP Steel Cased H.R.T. Boilers.
2—84 x 20' HRT Steam Boilers 260 HP.
20 Ton American Steel Guy Derrick, 100 ft.
10 Ton Steel Stiff Leg Derrick, 80 ft. boom.
1500-3000' Motor Driven Compressors.
25 and 35 Ton Locomotive Cranes.
35 Ton Plymouth Gasoline Locomotive.
Water Tube Boilers—Air Compressors.
Steel Sheet Piling—Pile Hammers, etc.

Mississippi Valley Equipment Co.

507 Locust St. St. Louis 1, Mo.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500 to 5000 KW condensing, non-condensing turbos
100 to 1000 HP Diesels
200 to 1000 HP 200# or better pounds boilers
Also, operable older equipment (15 yrs. or more) for export

750 KW and/or 1250 KW N.C. 60/3/480/200#/20# B.P.
2500 KW N.C. 60/3/480/200#/20# B.P.—20,000 KW 60/3/2300/400# Cond.
200 HP Heine boiler, modern, 175-200# with Stoker
400 HP—1000 HP 400# plus. S.H. stoker equipped

WORTHY USED POWER UNITS — WORTHWHILE BARGAINS

TURBOS

12,500 KVA 2-6250 KVA Wemco 76 CW frame, 60/3/2300/200# equal new.
5,000 KW G.E. Curtis 5 stage Cond.
4,000 KW Cond. 200#, 125° S.H. 60/3/2300V with jet or surface cond.
2,000 KW Wemco 60/3/440/180# surface condenser.
1,250 KW Wemco Cond. or Bldr. 60/3/480V/150#/120°/3600 RPM very economical performance Cond. Bldg. 15#G, 15,000# per hr.
1,500 KW Wemco Parsons Cond. 1000 KW noncond. 60/3/2300V N.C. 10# exhaust at 1000 KW with Wheeler surface cond. all aux.
1,250 KVA Allis A.C. 60/3/2300/3600 RPM Cond. 150/200° ISP 100° S.H. with jet condenser, all aux. Rugged turbine, price low.
1,560 KVA Wemco A.C. 60/3/600/3600 RPM, with mixed flow regulator and Wemco 42 sq. ft. surface cond.
500 KW G.E. 60/3/480/200# single flow 3600 RPM N.C. Bldr. 15/50 G.B.P. buckated in low; all aux.
625 KVA 60/3/2300V. 185#/100 S.H. exhaust pressure 110#.
3—400 KW Wemco Bleeders. 60/3/220/3600/150#/100° S.H. Bld. 10#G.
300 KW High Speed Cond. 60/3/2300. All aux. including boiler complement.

BOILERS

1—1250 HP steam generation plant, complete. Superheater, Economizer, Steel encased with 14 retort underfeed stoker, 100,000# continuous.
4—1000 HP B&W Stirling type ASME code, 200# with underfeed stokers.
1—750 HP 170# Edgemoor waste heat, ASME.
1—612 HP 200# 125° S.H. Stirling type, ASME.
4—500 HP 190# Heine, 150° S.H. ASME.
2—500 HP B&W 200# 100° S.H. with Comb. Eng. Type E. stokers, all aux.
1—444 HP Union Iron Works 200# 125° S.H. ASME.
3—400 HP—1—500 HP Casey Hedges; oil fired.
1—500 HP 170# 125° S.H. ASME. Combustion Eng. type E. stoker.
2—365 HP Edgemoor 200# 100° S.H. ASME ram type stoker.
2—356 HP 180# Comb. Eng. Type E stokers, all aux. ASME
2—352 HP—225# 3 drum, bent tube, with oil burners; new in 1937; 1 year's use.
3—316 HP Heine horizontal 170# waste heat boilers.
1—313 HP 250# Edgemoor, 125° S.H. with stoker.
2—300 HP Stirling 170#/100° B&W ASME.
2—200 HP Erie City HRT 150# new in 1929; stoker equipped.

GENERATORS

2—150 HP; 2—300 HP; 1—500 HP Diesel engine generators.

STOKERS

2—Hoffman Fireite Stokers.
1—5 Retort Westinghouse.

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

Rebuilt Motors

3 Phase, 60 Cycle, 220/440 Volts

HP	Make	Type	RPM
400	General Electric	I-K	900
400	General Electric	I-K	900
350	General Electric	I-K	900
250	General Electric	I-K	900
200	General Electric	KT357	1800
200	General Electric	I-K	900
200	General Electric	I-K	720
150	General Electric	KT357	1200
150	Westinghouse	CCL	900
125	General Electric	KT347	1800
100	General Electric	KT347	1200
75	General Electric	KT543	1800
60	General Electric	KT343	1200
60	Burke	EM7	870
60	General Electric	KT346	900
50	Westinghouse	CS	1800
50	General Electric	KT327	1800
50	Westinghouse	CS-646A	870
50	Reliance	IJ	1800
40	Westinghouse	CS	1800
40	Westinghouse	CS	1800
40	General Electric	KT323	1800
40	General Electric	KT323	1800
40	General Electric	KT523	1800
40	Burke	EM45	1200
35	Lincoln	D-411	1800
30	Westinghouse	CCL	720
30	General Electric	KT332	1160
*30	Armor	A	850
25	General Electric	I	1150
*20	Armor	ET-416	850
*20	Fairbanks Morse	H	900
*20	General Electric	KG-405	880
20	General Electric	KG-404	1150
20	General Electric	KT312	720
20	Fairbanks Morse	H-12A	850
15	Crocker Wheeler	1100	560
15	Crocker Wheeler	114Q	1800
10	Star	AX	3500
10	Century	SC	685
10	General Electric	KT312	900
10	Lincoln		1200
7½	Fairbanks Morse	B	1200
7½	General Electric	KT954	1200
7½	Wagner	14VBP	1800
5	Westinghouse	CCL	3400
3	U. S.	FRB	1800
3	Fairbanks Morse		900
*1	Master	PA	3425

25 CYCLE GAS GENERATOR SET
70 HP. 4 cyl. 500 RPM Gas or Gasoline Engine direct connected to 45 KW Gen. Elect. Generator—25 cy. 3 ph. 220/440 V. 500 RPM—Price $2,750.00 on Foundation—Buffalo.

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write for our
NEW LIST
from plants just purchased

TRANSFORMERS
3—150 KVA Moloney Electric Co. 2200 v. Primary—220/440 v. Secondary 1 phase 60 cycle with taps.
3—200 KVA. Westinghouse Electric Co. 2400 volts primary—480 volts secondary 1 phase 60 cycle with taps.

SLIPRING MOTORS
60 Cycle, 3 Phase, 220/440 Volts

HP	Make	Type	RPM
500	Westinghouse	CW	575
400	General Electric	I-M	900
250	General Electric	I-M	900
250	Allis Chalmers		505
200	General Electric	I-M	900
75	General Electric	MT-546	900
50	Westinghouse	CW	700
40	Westinghouse	CW-748	690
40	Westinghouse	CW-748-A	690
40	Westinghouse	CW-748	690
40	Westinghouse	CW-748	690
40	Westinghouse	CW-748	690
30	Westinghouse	HF	1745
*20	Westinghouse	CW-644C	575
20	General Electric	MT-332	545
15	General Electric	I-M	900
15	General Electric	MT-322	855
13	Sachsenwerk	D7318	850
11	General Electric	ITC-5008	820
10	General Electric	MT303Y	1800

* Ball bearing. ** Sealed sleeve bearing.

MOTORS
25 Cycle—3 Phase—2200 Volts
100 H.P., General Electric, type KT558, 750 rpm, serial number 5227257, ball bearing.
100 H.P., Allis Chalmers, type AR, ball bearing, 1500 rpm, serial number 42209K426N-1-1.
150 H.P., General Electric, ball bearing, type KT557Y, 1500 rpm, serial number 5269756.

MOTOR GENERATOR SETS
1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC—Motor 3/60/2300/900 RPM complete with panels.

FREQUENCY CHANGER SET
1—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM direct connected to Generator 362½/440 V. Complete with exciters and panels.

200 KW. 25 Cycle, M. G. Set
200 KW. Gen. Elect. Generator, 240 V. DC. 750 RPM. Type MPC. on Factory Base direct connected to 300 HP. Gen. Elect. Type I Form K. 3/25/440 V. 750 RPM. Complete with Motor Starting Equipment and DC. Panels.

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500 KW. DC generator, 600 v. DC 900 speed, Allis Chalmers. Can assemble motor generator set

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312 KVA. West. synchronous frequency changer, 440 v. 30 cy. input, 440 v. 60 cy. output, 900 rpm.

100 KW. 125 volt, General Electric, 1200 rpm. motor generator set any AC voltage.

100 KW. 250 volt, Westinghouse, motor generator set synchronous drive. Any voltage.

70 KW. Motor Generator Set, 70 v. 1000 Amp. Burke, synchronous drive.

667 KVA. transformers 23,000 volt primary 440 v. sec. 60 cy. single phase. Three units available.

35 KW. 125 volt motor generator set. Any AC voltage drive.

50 — New 3 HP. General Electric, 1800 rpm. 220 volt slip ring motors.

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General Electric Turbo-Generator Extraction Type, condensing—125 volts D.C. Complete with surface condenser, pumps, accessories and switchboard. Can be seen in operation

Condition practically equal to new

6700 CFM

General Electric Centrifugal Compressor 22# gauge discharge pressure. Driven by 675 H.P.G.E. Turbine. Condensing type. Will develop 10,000 CFM by installing new first stage nozzles. Complete with surface condenser, expansion joints, butterfly valve and atmospheric relief valve.

Condition excellent

4100 Sq. Ft.

C. H. Wheeler, 2 Pass Surface Condenser complete with pumps. Condition excellent.

Write or wire for additional data and prints.

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The Buyer Must Be Satisfied—Always

4000 KVA. 60 CY. 3 PH. TURBO WITH SURFACE COND.
100 KW—550 V. TURBO 3600 Rev. 60 cy 3 ph—with exciter
1500 CFM 2 STAGE AIRCOMP. 275 HP. 60 Cy. 2200 V. Syn. Motor
HEAT EXCHANGERS 606 TUBES 1¼"x9'6", 24" Back Pressure Valve
HYDRO ELECTRIC UNITS 60 CYCLE

1625 KVA. 60 Cy., 250 RPM
750 KW. 360 RPM 60' Head
20" VALVES—P&D, also Ells & Tees
2—CENT. PUMPS 4166 GPM 162' Head
1—36000 GPM, 27' Head CENT. PUMP.
700 KW. 257 RPM Hydro Unit
1500 HP. Impulse, 150 RPM Hydro Unit
1600 HP. 550' Head Hydro Unit

MANY OTHER PUMPS

1000 HP. 514 REV., MILL TYPE MOTOR
2300 V. 60 Cy. 3 Ph. USED 2 MONTHS (Enclosed)
1500 AND 2500 HP, 60 CY. A.C. MOTORS
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Motor Generator Sets—Synchronous Motors, Etc.

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1—West. 500 KW 275 or 600 Volt D.C. 720 RPM, 2300 Volt 80% P.F. 720 HP A.C.

VERTICAL MOTORS

1—Reliance fan-cooled 25 HP 1750 RPM 220/440 Volt

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A.C.

1—Ideal 3-bearing 250 HP 600 RPM 440 Volt
1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS, 3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G.E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTOR SPECIAL
3 phase, 60 volts

5—West. frame 405, 20 HP 900 RPM TEFC 220 Volts.

D. C. EQUIPMENT

13—Clark Bulletin 5370 30 HP 230 Volt. D.C. automatic starters—none used over two months.
A large number of adjustable speed D.C. motors from 5 to 150 HP

ALTERNATORS SPECIAL, Allis-Chalmers, 125 KVA 277 RPM 3 Phase, 60 cycle

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FOR
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150 KW MOTOR GENERATOR SET

150 KW Westinghouse "factory built" Synch. Motor Generator Set. Type SK Generator for 250 volts DC compound wound interpole. 225 HP Type G Synch. Motor for 3/60/2300 volts, speed 900 RPM, complete with Westinghouse Switchboards.

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SLIP RING MOTORS
3-HP., 60-CY

HP	Volts	Make	Speed
900	2300	G.E.	900
150	220/440	G.E.	1800
300	2200	G.E.	1800
300	2200	Whse.	514
300	440–220	Al. Ch.	900
250	2300	G.E.	600
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–400	G.E.	600
188	440–220	G.E.	1800
150	440	G.E.	1800
150	550–2200	G.E.	1800
140	550	G.E.	720
125	2200	G.E.(NEW)	1800
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
100	440–220	G.E. MTC	900
75	220–440	G.E.	900

SYNCHRONOUS MOTORS
3-HP., 60-CY

600	2300	Whse.	900
350	440–220	G.E.	900
300	440/220	Al. Ch.	600
300	2300	Whse.	900
110	440	Whse.	900
100	2200–550	Al. Ch.	1800
100	440–220	G.E.	360
75	440–220	G.E.	720

PUMP
1—6" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

UNAFLOW ENGINE-GENERATOR SET consisting of:
Gen: 250 KW 200 RPM 250 volt direct connected to:
Eng: 23" x 24" Ames Unaflow 125/150# ga. non-condensing. Very modern—practically new.
1—11" x 12" Ames non-condensing Steam Engine, direct connected to a 60 KW Crocker-Wheeler 250 volt DC Generator.

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60 CYCLE

3—500 Kva., G.E., Type H, Form KDD 13200-2300 V.
3—500 kva., G.E., type H, form KS, 13800-230/460
3—333 kva., G.E., type H-KDD 2400-400/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H, 34500-2300 V.
1—200 kva., G.E., type HT, 13200/26400/480 V. 3 ph.
3—150 kva., G.E., type H KDD, 6600/11430Y 1300 V.
3—150 kva., G.E., type H-KDD 13200-2300.
3—150 kva., Al. Ch., type OISC 10400-2400.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., G.E., type H-KR 6600/11430Y-2300 V.
3— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
350	440/220	G.E.	IK	900
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
250	2200	Whse.	CS	1200
250	440/220	G.E.	IK	1800
200	220/440	G.E.	IK	720
200	440/220	G.E.	IK	900
150	440/220	G.E.	IK	900
150	2200	Allis Ch.	AN	450
150	440/220	Whse.	CS	514
125	440/220	G.E.	KT	1800
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
60	550	G.E.	FT	3600
50	220/400	G.E.	K	1800

MOTOR GENERATOR SETS
1—125 KW, 125 V., 1200 RPM, G. E. conn. to 175 HP, 1200 RPM, 440 V. 3 ph. 60 cy. Syn. motor.
1—75 KW, 250 V, 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V, 850 RPM, Whse. conn. to 75 HP, 440/220 V, 3 ph. 60 cy. Sq. Cage Motor.

A.C. GENERATORS
1—500 kva., 900 r.p.m., 2209 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—187 kva., 900 r.p.m., 550 V. Whse.
1—110 kva., 900 r.p.m., 440 V., G.E.
1—96 kva., 360 r.p.m., 480/240 V. G.E.
1—62½ kva., 1200 r.p.m., 2200 V. Cr. Wh.
1— 60 kva., 720 r.p.m., 240/480 V., G.E.
1— 25 kva., 3600 r.p.m., 220 V., G.E.

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HARRY J. RICE PRES.
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A-C ENGINE GENERATORS

3—75 KW. Caterpillar D-13000, must be sold together. Received 1942.
3—Fairbanks Morse, 250 KW & 148 KW. are model 32-E-14. 240 KW. is type Y, style VA. All 2300 v.
1—250 KW. Winton, 240 v. Operating. Others from 15 KW. to 15000 KW.

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4—1000 H.P. Heine 225# Boilers
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2— 600 H.P. Edge Moor 200 # Stokers
2— 570 H.P. B. & W. Sectional 200#
2— 600 H.P. B. & W. Stirling 200#, with Stoker
5— 590 H.P. B. & W. 200#, with Stokers
6— 440 H.P. B. & W. Sectional 200#. Oil fired
1— 335 H.P. B. & W. Sectional 200 Boiler
Smaller Boilers and Fire Tube Boilers also

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3—4000 KW., G.E. Co., Turbo-Generator Cond.
1—3200 KW., Allis-Chal., Turbo-Generator Con.
2—2500 KW., G.E. Co., Turbo-Generator Condensing
2—2000 KW., G.E. Co., Turbo-Generator Condensing
1—2000 KW., W. E. & M. Co., Turbo-Generator Con.
3—1000 KW., G.E. Co., Turbo-Generator Condensing
2— 750 KW., G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller. And Non-cond. Units.

50 Ton 69'-10" Overhead Traveling Crane.

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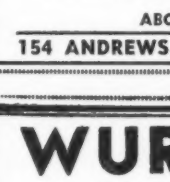

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1—2000 A. GE CK 8 Air Breaker 3 PST 600 V. O.L. & U.V.
1—3000 A. GE FK 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

Sq. Cage.—220/440 V. 60 cy. 3 ph.

Qu.	HP	Make	Type	Speed
2	50	G.E.	KT 327	1800
2	100	G.E.	IK	1800
1	150	West.	CS	1800

Slip Ring—220/440 V. 60 cy. 3 ph.

1	40	West.	CW	720
1	50	G.E.	I-M	900
1	60	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

D.C. Variable Speed 230 V.

1	15	West.	SK	400/1600
1	25	West.	SK	400/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

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1—50 KVA Eng.-Gen. Set; 75 HP S. Marine Boiler
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3—253 HP Vogt low head Boilers, 225# pressure with oil burners, all auxiliaries. New in 1937.
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1—444 HP Union Iron Works Boiler, 225# pressure.
1—624 HP Edgemoor Boiler, 200# pressure, underfeed stoker.
2—512 HP Stirling 200# pressure, completely rebuilt.
4—72" x 18' HRT boilers including a 637 KVA General Electric condensing turbine. Complete plant.
2—175 HP Brownell HRT Boilers, 150# pressure, rebuilt.

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1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
15,000 KVA Westinghouse turbine, condenser.
1—250 KVA Waite Turbine either condensing or non-condensing.

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1—625 KVA Nordberg Uniflow engine.
1—1060 KVA Nordberg Uniflow Engine Generator.

DIESEL ENGINES

1—200 KVA Fairbanks-Morse Full Diesel Engine Generator.
1000 KVA Diesel Generator Plant complete.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
1250 KVA Nelseco engine generator.

ENGINE GENERATOR SETS

1—340 KVA Skinner Uniflow Engine Generator set with panel board.
1—400 KVA Allis-Chalmers non-releasing Corliss.
1—625 KVA Bates Corliss engine.
1—7 ft. diameter by 175 ft. self-supporting stack.

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54,000 pound Cochrane hot process lime and water softener.
2500 HP Cochrane Open Feed Water Heater.
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4—Fairbanks Morse 60 HP, 6 cyl. 4 cycle Model 36, size 4¼"x6", 1200 RPM Diesel Engines.
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5—Horizontal multipass shell and tube condensers measuring 15" in diameter x 216" long furnished complete with removable heads, bolts, gaskets, intermediate stands and floor stands.
1—Fairbanks Morse 1¼" Fig. 525 circulating water pump without motor.
4—Falk Gear Reducers Type 7 HC 50 HP.

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2—100 HP Scotch Marine Murray Boilers, built to Hartford Code, complete with all accessories, located at the Mountain States Power Company plant at Riverton, Wyo. our property, subject to inspection at any time. Priced to move, with accessories, $1,000.00. Write or wire the undersigned, or our local agent, A. J. Moore, Worland, Wyo.

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FOR SALE

2—General Electric Traction Generators. 190 hp. Model 5-GT-555-A, 4 pole, D.C. commutating pole type. Designed for use with the 380 hp, 47 ton Diesel-Electric locomotive manufactured by the General Electric Co. These generators have never been in use. For further particulars write or cable the

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2 STOKERS

Make: Flynn & Emrich—Age 2 Years

Series 70E unit type heavy duty underfeed, 550 H.P. each—furnace width 7½ ft.
Equipment only cost $5643.00—sacrifice

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SYNCH. CONVERTERS

500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

500 KW WEST. SYN. 250 V. 2300 A.C. 900 RPM
200 KW G.E. IND. 600 V. 2300/4000 A.C. 1200 RPM
200 KW RW SYN. 250 V. 2300/4000 A.C. 900 RPM

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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384—Macklin Grinding Wheels, Size 8" dia. x 1" thk. x 5/8" Arbor Hole, Grain #20, Grade G-5
575—Abrasive Grinding Wheels, Size 8" dia. x 1" thk. x 5/8" Arbor Hole, Marking 16-U-B-A-7
10—Morse Special Drills, 37/64" dia., 4 Flute, 18" Flute length, High Speed Steel with 2" Sellers Taper Shank

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G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3500	140′	Kingsford	Centrif.
2400	55′	American	Centrif.
1100	220′	Allis-Chalm.	Centrif.
1500	180′	Penna	Centrif.
1500	160′	DeLaval	Centrif.
400	625′	LeCourtenay	Centrif
250	525′	LeCourtenay	Centrif.
400	350′	Goulds	Triplex
300	500′	Goulds	Triplex
175	500′	Goulds	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
300	150′	Viking	Rotary
200	175′	Blackmer	Rotary
1000	460′	Knowles	Steam
750	460′	Snow	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

M. G. & STEAM DR. SETS

K.W.	Make	Volts	Type
25	Geen Eng.	220	Belt Drive
100	Ames	240	dir. dr. Eng.
75	Ames	240/120	dir. dr. Eng.
17	Sturt. Turb	110	Direct Drive
7½	Strut. Turb	110	Direct Drive

D.C. MOTORS ALL SIZES

100	Northwest	220	1750
85	Roth	230	1750
10	Crock. Wheel.	110	925
10	Wesche.	110	1700

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850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
250	100	Sullivan	Horiz.
125	100	Gardner	Vert. Dup.
173	100	Ing. Rand	Horiz.
28	5000	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

3000	16 lbs.	In. Rand	Motor dr.
3000	8 lbs.	In. Rand	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24 oz.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor dr.

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C.F.M.	Sr. Pres.	Make	Type
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100–15000	¼"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press	Make	Type
10000	2 lbs.	Roots	Belt dr.
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Direct dr.
110	15 lbs.	Beach R	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth	Belt dr.
100	high vac	Beach R	Gear dr.
100	27 in.	Deane	Belt dr.
100	29 in.	Devine	Belt dr.

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300	G.E.	2300/4000	1800	Syn
150	West.	440	700	CS
125	G.E.	220	1150	Vertical
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCI
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	sl. rg.
10-30	All Makes			

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ENGINE GENERATOR SET

SPECIFICATIONS

Generator	Engine
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Amps. 600	Bore & Stroke 16 x 20
R.P.M. 200	Four valve,
Compound Wound	non-releasing

Equipped with Allis Chalmers 13.3 K.V.A., A.C. transformer and panel board.

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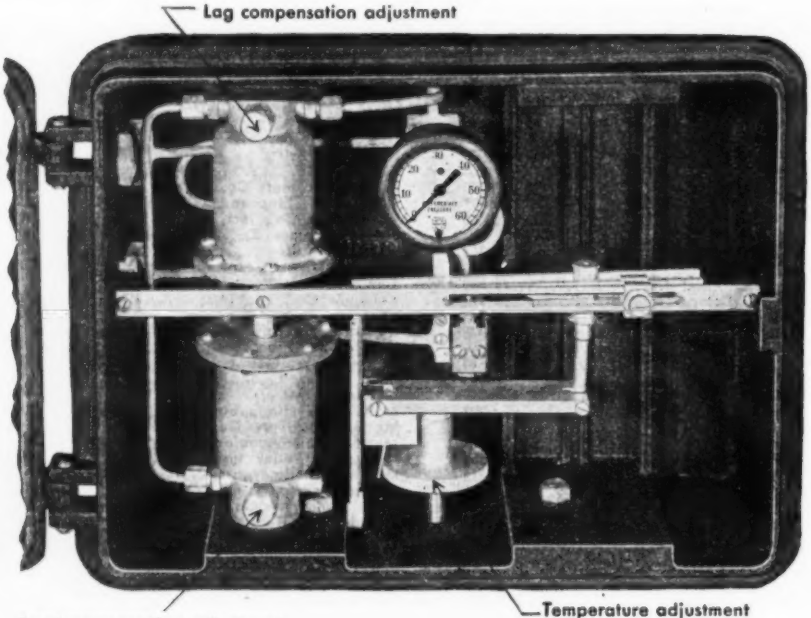
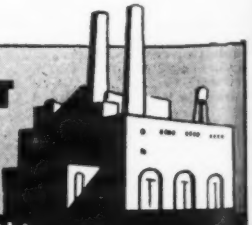
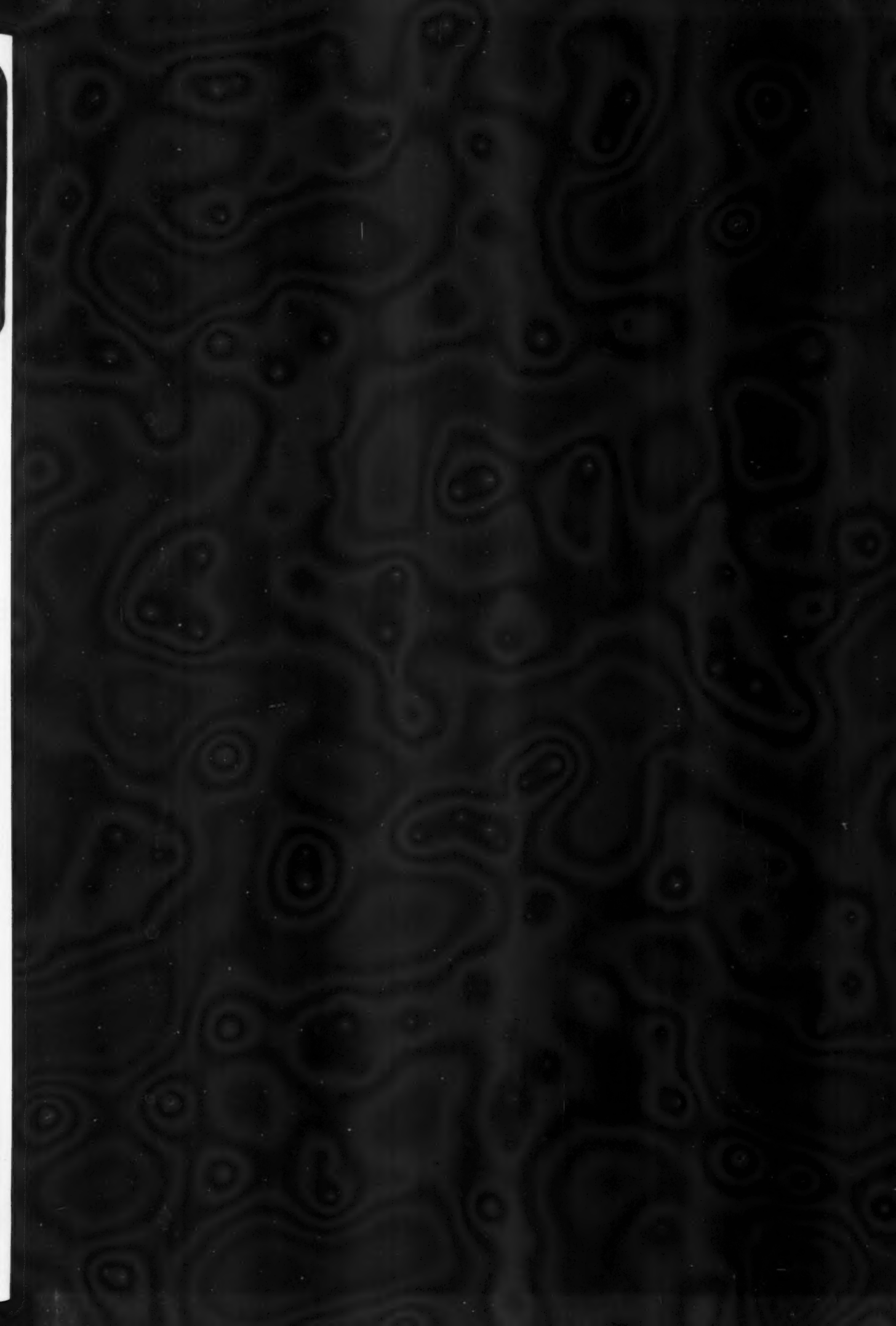
● Especially designed for maintaining temperatures where accuracy and dependability are of utmost importance, this new Swartwout Thermo Master Control combines unusual sensitivity with the rugged construction which characterizes Swartwout Equipment. Used on temperatures of 50° to 950°—at any pressure—in steam desuperheating and other process requirements involving vapors and fluids.

Type T-1 Thermo Master Control reflects the thoroughness of Swartwout engineering—benefits by the many years of Swartwout experience in providing complete reducing and desuperheating stations and a wide range of power controls. For more complete details on this new Temperature control, write for Data Unit No. S-197.



Direct contact of a bimetallic control element with the steam or fluid being regulated brings immediate response to temperature changes. Flow regulating valve in the process installation is affected within a fraction of a second after change of temperature at the control element.

Swartwout POWER PLANT EQUIPMENT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